KINGS BEACH COMMERCIAL CORE TRAFFIC STUDY

Draft Study Report

Prepared for the

Placer County Department of Public Works

Prepared by

LSC Transportation Consultants, Inc.

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Chapter 1
Introduction

Placer County is developing a plan to implement streetscape improvements for the State Route (SR) 28 commercial corridor in Kings Beach, California. A key question regarding this project, for both the County and the community, is the appropriate roadway and intersection configurations for the state highway corridor. To provide a quantitative understanding of the conditions that would result from various alternatives, LSC Transportation Consultants, Inc. has be retained by the Placer County Department of Public Works to evaluate traffic conditions under two corridor alternatives.

The traffic study area is defined as the SR 28 corridor between (and including) Chipmunk Street on the east and SR 267 on the west, including all intersections within this corridor with public streets. To the degree necessary to assess project impacts, other roadway elements (such as residential streets within Kings Beach) will also be evaluated. Note that this study area is larger than the proposed streetscape area, in order to address impacts and conditions outside of the streetscape area.

Two roadway alternatives are evaluated as equal alternatives: a four-lane cross-section on SR 28 with traffic signals located at Coon, Bear and SR 267, and a three-lane cross-section on SR 28 with modern roundabouts at Coon and Bear, and a traffic signal at SR 267. Under either alternative, Brook Avenue from Bear Street to Coon Street would be converted to one-way eastbound. In a separate discussion, the impacts associated with a modern roundabout versus a traffic signal at the SR 28/SR 267 intersection are evaluated. In addition to the review of existing traffic conditions, two design years are considered: a "near-term" year corresponding to the first year of project implementation (assumed to be 2008), and a "long-term" year 20 years in the future (2028).

Chapter 2
Existing Traffic Conditions

Roadways in the study area can be characterized as follows:

- State Route 28 is the major roadway serving Lake Tahoe's North Shore, linking Kings Beach with Incline Village, Nevada to the east and Tahoe Vista and Tahoe City to the west. In the vicinity of the site, SR 28 is a four-lane facility with two lanes of travel in each direction. East of Kings Beach and west of Tahoe Vista, SR 28 is a two-lane facility. The posted speed limit on this segment of SR 28 is 30 miles per hour.

- State Route 267 is a two-lane highway located running in a general northwest-southeast alignment between Interstate 80 in Truckee and State Route 28 in Kings Beach. This highway consists of two travel lanes, with a speed limit of 55 miles per hour in the rural sections.

- Local streets in the Kings Beach area consist of a grid of north-south streets mostly named after mammals (such as Chipmunk Street, Fox Street, Coon Street, Bear Street, and Deer Street) intersected by east-west streets mostly named after fish species (such as Speckled Avenue, Dolly Varden Avenue, Trout Avenue, and Brook Avenue). These Placer County roadways all provide a single travel lane in each direction.

Traffic control at intersections in Kings Beach is currently provided by Stop signs on side street approaches, with the exception of traffic signals located at the SR 28 / SR 267 and the SR 28 / Coon Street intersections. The only dedicated turn lanes consist of eastbound and westbound left-turn lanes and a southbound right-turn lane at the SR 28 / SR 267 intersection. A map depicting the area roadways is presented in Figure 1.

TRAFFIC DATA

Historical traffic volumes along SR 28 near the study area were obtained from Traffic Volumes on California State Highways (Caltrans, 1992-2002), and are presented in Table 1. A review of this table yields the following conclusions:

- Annual Average Daily Traffic (AADT) volumes have increased at a rate higher than the Peak Month Average Daily Traffic (PMADT) volumes in the area. On SR 28 between SR 267 and Coon Street, AADT increased by 2,000 between 1992 and 2002, while PMADT volumes actually declined by 100.

- While this drop in PMADT is reported for SR 28 west of Coon Street, for the segment of SR 28 to the east of Coon Street PMADT increased by 600 vehicles per day between 1992 and 2002.

- Except for SR 28 east of SR 267 and SR 267 over Brockway Summit, peak-hour traffic volumes were reported to decline on the state highways between 1992 and 2002.

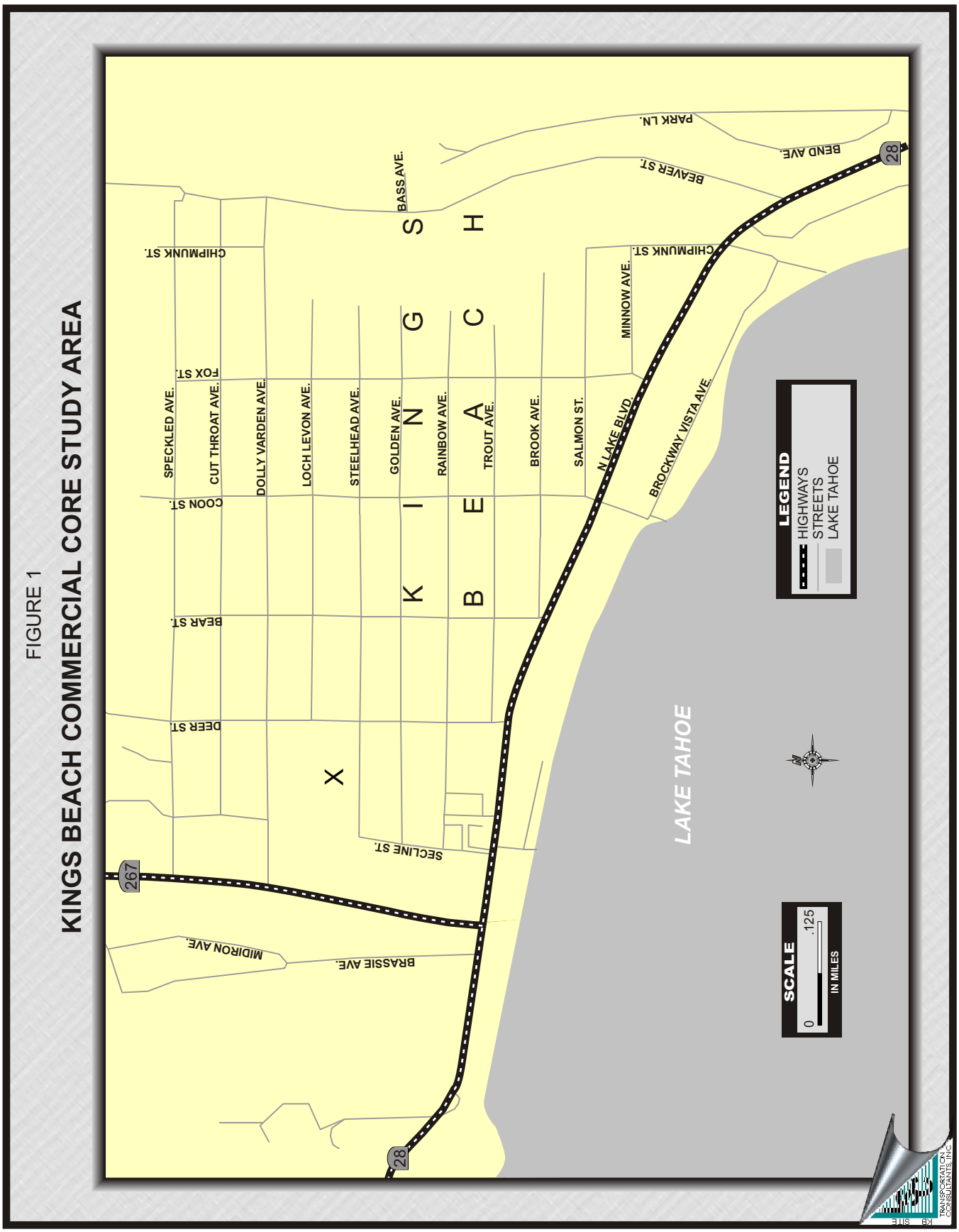


FIGURE 1
KINGS BEACH COMMERCIAL CORE STUDY AREA
LEGEND
HIGHWAYS
STREETS
LAKE TAHOE
SCALE
0
.125
IN MILES
LAKE TAHOE
N LAKE BLVD
BROCKWAY VISTA AVE.
MINNOW AVE.
SALMON ST.
BROOK AVE.
TROUT AVE.
RAINBOW AVE.
GOLDEN AVE.
STEELHEAD AVE.
LOCH LEVON AVE.
DOLLY VARDEN AVE.
CUT THROAT AVE.
SPECKLED AVE.
CHIPMUNK ST.
FOX ST.
COON ST.
BEAR ST.
DEER ST.
SECLINE ST.
BASS AVE.
BEAVER ST.
PARK LN.
BEND AVE.
CHIPMUNK ST.
MIDIRON AVE.
BRASSIE AVE.
267
28
28
KINGS BEACH
N
SITE
TRANSPORTATION CONSULTANTS, INC.

TABLE 1: 1992-2002 Caltrans Traffic Counts on State Routes in Kings Beach Area

Route	Location	1992 2-Way Traffic Volumes			2002 2-Way Traffic Volumes			Annual 1992-2002 Change		
		Average Annual Daily	Peak Month Avg. Daily	Peak Hour	Average Annual Daily	Peak Month Avg. Daily	Peak Hour	Average Annual Daily	Peak Month Avg. Daily	Peak Hour
28	West of SR 267 in Tahoe Vista	16,800	23,900	2,200	18,100	23,700	2,250	0.75%	-0.08%	0.22%
28	East of SR 267 in Kings Beach	17,100	24,200	2,100	19,100	24,100	2,050	1.11%	-0.04%	-0.24%
28	East of Coon St. in Kings Beach	13,200	18,800	1,700	15,100	19,400	1,650	1.35%	0.31%	-0.30%
267	South of Northstar Drive	6,700	8,800	920	8,100	9,900	1,150	1.92%	1.18%	2.26%
267	North of North Avenue	7,800	10,500	1,000	8,500	10,800	800	0.86%	0.28%	-2.21%
267	North of SR 28	8,000	11,100	1,000	9,200	11,900	880	1.41%	0.70%	-1.27%

Source: Caltrans web site, and 1992 Traffic Volumes on California State Highways.

Traffic data for years prior to 1992 is also useful in providing a context to traffic issues in the community. Caltrans District 3 provided the following peak-month average daily total traffic volume counts for SR 28 to the east of SR 267:

1960	8,400	1975	20,500
1966	14,400	1980	29,000
1970	18,100	1985	23,700

As shown, peak month daily traffic volumes have exceeded 20,000 vehicles per day for at least the last 28 years, and actually reached levels in 1980 that exceed the most recent Caltrans counts by roughly 4,900 vehicles per day.

Summer 2002 SR 28 Hourly Count Data

More detailed data regarding summer traffic volumes along SR 28 was collected from the Caltrans count station located on SR 28 just to the east of SR 267. Hourly counts were conducted in both directions from June 2, 2002 through September 30, 2002, as presented in full in Appendix A. Based upon a review of this data, the data was analyzed for a summer season defined as Friday June 14, 2002 through Sunday, September 15, 2002.

A summary of total daily traffic volumes recorded at this location is presented in Table 2, and depicted in Figure 2. As shown, there is a strong weekly variation in traffic volumes, with the highest traffic volumes typically observed on Saturdays or Sundays, and the lowest volumes observed on Monday or Wednesday. The highest total traffic volumes were recorded on Friday, July 5th, with a total two-direction traffic volume of 32,708. Traffic activity then falls before a second peak period the first few weeks of August, after which volumes generally decline except for a spike around Labor Day weekend. The peak month (August) average daily traffic volume was reported to be 25,179.

It is also useful to examine hourly directional traffic volumes over a busy summer weekend period. As depicted in Figure 3, there is a strong eastbound traffic flow on Friday afternoon/evening, which can be assumed to consist largely of drivers traveling to Incline Village for the weekend. Volumes on Saturday reach high levels between roughly 10 AM and 6 PM, with slightly higher volumes in the westbound direction than the eastbound direction (this imbalance is also found at other locations across the North Shore). On Sunday, there is a strong mid-day peak in traffic volumes in the westbound direction, which probably largely reflects motorists leaving the Incline Village area at the end of the weekend.

This hourly count data is also very useful for purposes of this study to evaluate the distribution of the number of hours per summer season that experience various levels of traffic activity. Table 3 presents a summary of the number of hours per summer by traffic activity level, aggregated into ranges of 10 vehicles per hour. Table 4 and Figure 4 presents this same information in a more readily understandable format, aggregated into ranges of 100. Not surprisingly, the largest proportion of hours (the middle of the night period) have traffic volumes of less than 100 vehicles per hour. At the opposite extreme, traffic volumes fall between 1,300 and 1,400

TABLE 2: Daily 2002 Traffic Volume on SR 28 East of SR 267

	Eastbound	Westbound	Total
14-Jun Fri	11,234	11,108	22,342
15-Jun Sat	10,486	10,217	20,703
16-Jun Sun	9,068	9,614	18,682
17-Jun Mon	9,880	9,916	19,796
18-Jun Tue	10,168	10,113	20,281
19-Jun Wed	10,323	10,535	20,858
20-Jun Thu	11,046	10,849	21,895
21-Jun Fri	12,377	11,844	24,221
22-Jun Sat	11,881	11,896	23,777
23-Jun Sun	10,126	10,967	21,093
24-Jun Mon	10,668	10,596	21,264
25-Jun Tue	10,706	10,645	21,351
26-Jun Wed	10,643	10,801	21,444
27-Jun Thu	11,258	11,167	22,425
28-Jun Fri	12,253	11,802	24,055
29-Jun Sat	11,836	11,536	23,372
30-Jun Sun	10,750	11,366	22,116
01-Jul Mon	11,864	11,606	23,470
02-Jul Tue	12,609	12,101	24,710
03-Jul Wed	15,444	13,833	29,277
04-Jul Thu	14,136	12,786	26,922
05-Jul Fri	16,478	16,230	32,708
06-Jul Sat	14,642	15,610	30,252
07-Jul Sun	10,892	12,545	23,437
08-Jul Mon	11,296	11,499	22,795
09-Jul Tue	11,553	11,492	23,045
10-Jul Wed	11,663	11,863	23,526
11-Jul Thu	12,247	11,975	24,222
12-Jul Fri	13,084	12,614	25,698
13-Jul Sat	12,744	12,386	25,130
14-Jul Sun	11,278	11,918	23,196
15-Jul Mon	11,205	11,489	22,694
16-Jul Tue	11,457	11,382	22,839
17-Jul Wed	11,419	11,288	22,707
18-Jul Thu	11,912	11,660	23,572
19-Jul Fri	13,628	12,812	26,440
20-Jul Sat	13,489	13,101	26,590
21-Jul Sun	11,571	12,376	23,947
22-Jul Mon	11,564	11,773	23,337
23-Jul Tue	11,931	11,816	23,747
24-Jul Wed	12,392	12,222	24,614
25-Jul Thu	12,628	12,560	25,188
26-Jul Fri	14,561	13,336	27,897
27-Jul Sat	15,048	14,342	29,390
28-Jul Sun	12,855	14,302	27,157
29-Jul Mon	11,876	11,819	23,695
30-Jul Tue	12,263	12,171	24,434
31-Jul Wed	12,078	12,328	24,406
01-Aug Thu	12,877	12,620	25,497
02-Aug Fri	13,947	13,331	27,278
03-Aug Sat	13,917	13,589	27,506
04-Aug Sun	12,498	13,220	25,718
05-Aug Mon	12,653	12,986	25,639
06-Aug Tue	12,875	12,771	25,646
07-Aug Wed	12,941	13,086	26,027
08-Aug Thu	14,006	13,517	27,523
09-Aug Fri	14,725	14,190	28,915
10-Aug Sat	15,095	14,460	29,555
11-Aug Sun	12,909	14,026	26,935
12-Aug Mon	12,856	12,891	25,747
13-Aug Tue	13,086	13,299	26,385
14-Aug Wed	13,239	13,460	26,699
15-Aug Thu	13,397	13,236	26,633
16-Aug Fri	14,405	13,827	28,232
17-Aug Sat	13,722	13,244	26,966
18-Aug Sun	11,911	12,985	24,896
19-Aug Mon	11,484	11,895	23,379
20-Aug Tue	11,593	11,840	23,433
21-Aug Wed	11,670	12,033	23,703
22-Aug Thu	12,216	12,070	24,286
23-Aug Fri	12,924	12,614	25,538
24-Aug Sat	12,156	12,230	24,386
25-Aug Sun	10,258	11,385	21,643
26-Aug Mon	10,125	10,432	20,557
27-Aug Tue	10,190	10,477	20,667
28-Aug Wed	10,097	10,232	20,329
29-Aug Thu	11,019	10,606	21,625
30-Aug Fri	12,376	11,389	23,765
31-Aug Sat	13,153	12,286	25,439
01-Sep Sun	12,789	13,152	25,941
02-Sep Mon	9,833	11,438	21,271
03-Sep Tue	9,844	10,350	20,194
04-Sep Wed	9,465	9,581	19,046
05-Sep Thu	9,682	9,674	19,356
06-Sep Fri	11,378	11,092	22,470
07-Sep Sat	10,561	10,580	21,141
08-Sep Sun	8,834	9,495	18,329
09-Sep Mon	9,314	9,560	18,874
10-Sep Tue	9,315	9,324	18,639
11-Sep Wed	9,391	9,355	18,746
12-Sep Thu	10,315	9,967	20,282
13-Sep Fri	11,954	11,391	23,345
14-Sep Sat	10,898	10,886	21,784
15-Sep Sun	8,379	9,217	17,596

Figure 2

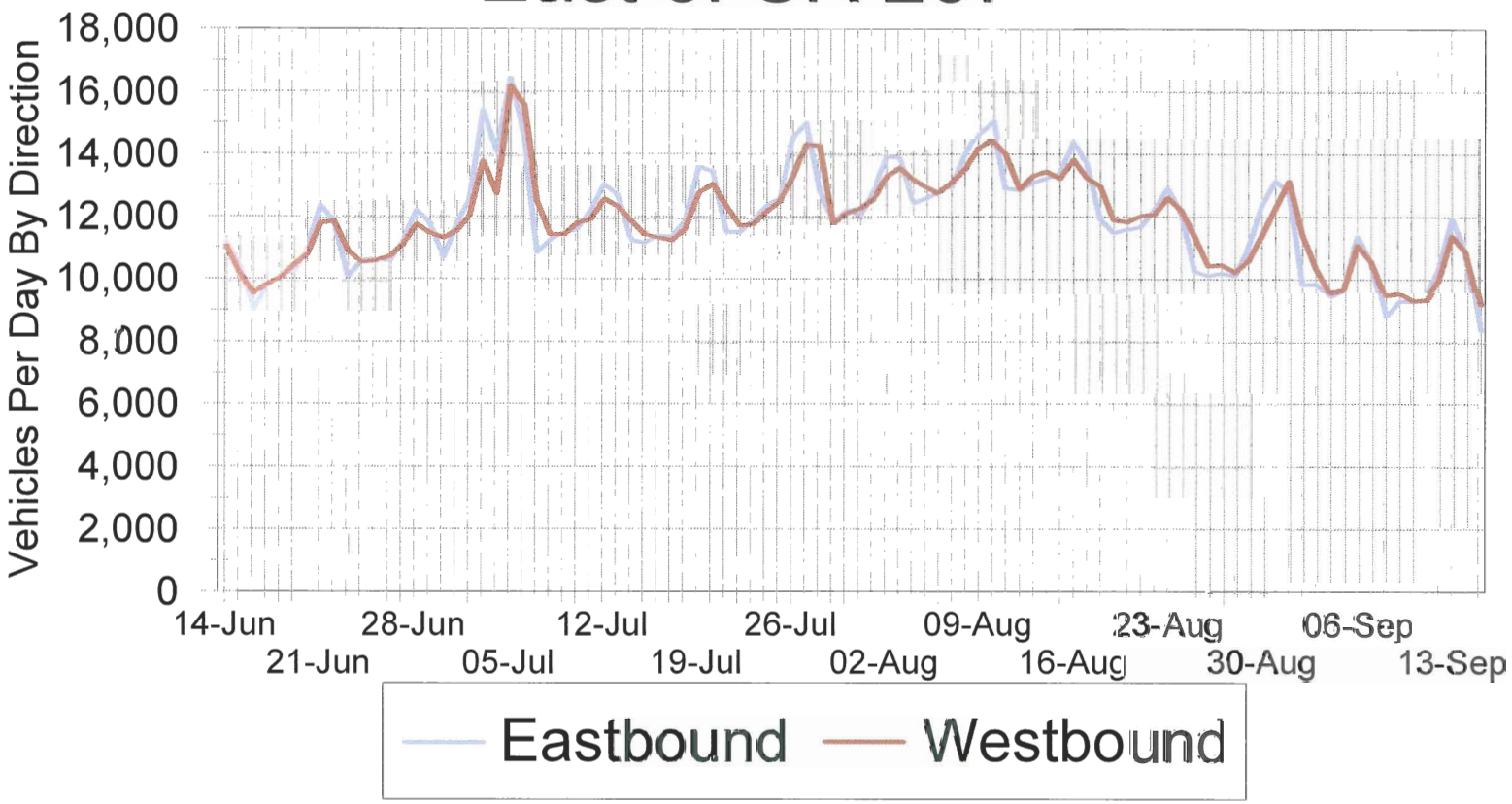

1-Way Daily Traffic Volumes on SR 28
East of SR 267
Vehicles Per Day By Direction
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
14-Jun
21-Jun
28-Jun
05-Jul
12-Jul
19-Jul
26-Jul
02-Aug
09-Aug
16-Aug
23-Aug
30-Aug
06-Sep
13-Sep
Eastbound
Westbound

Figure 3

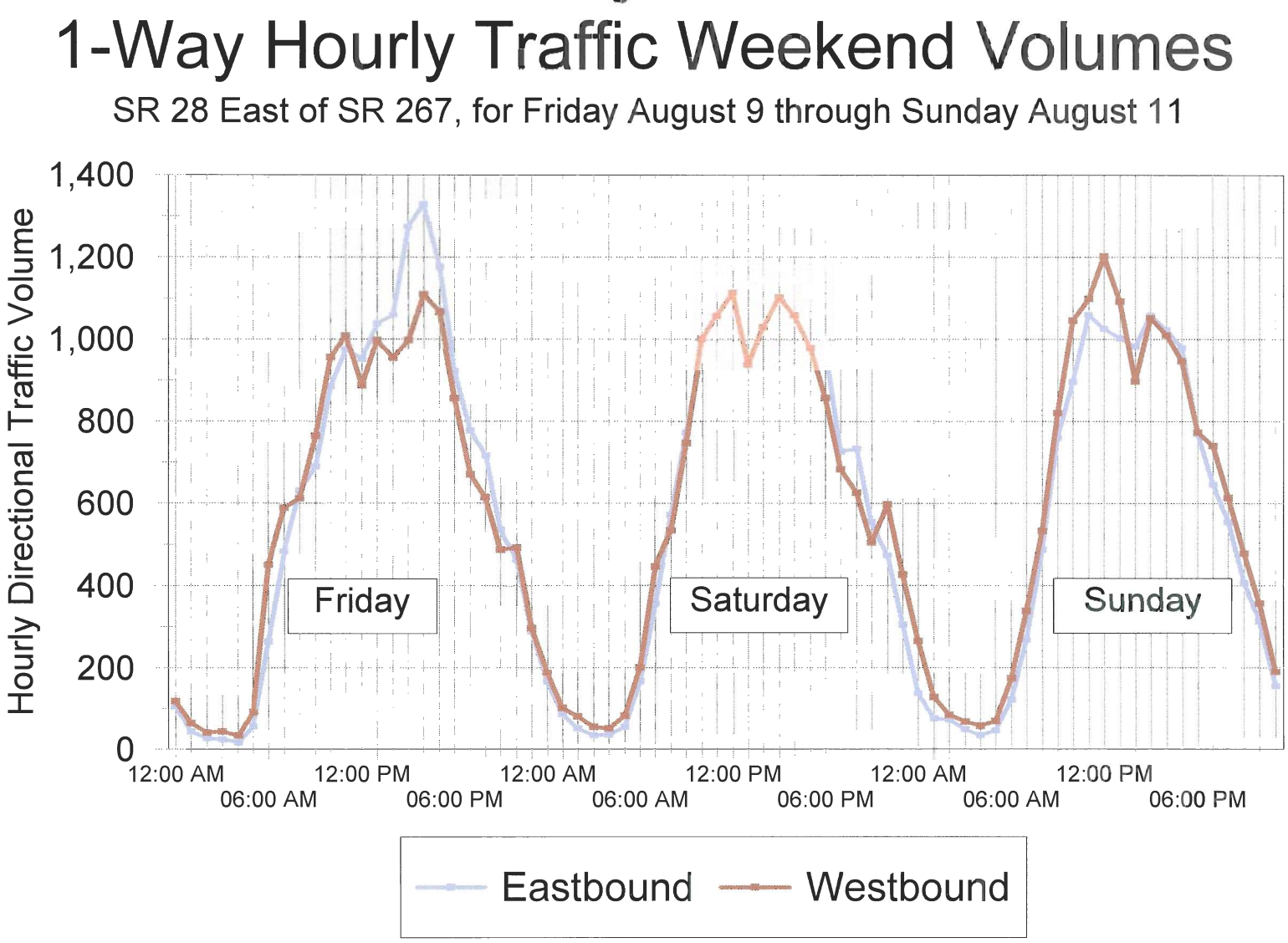

1-Way Hourly Traffic Weekend Volumes
SR 28 East of SR 267, for Friday August 9 through Sunday August 11
Hourly Directional Traffic Volume
1,400
1,200
1,000
800
600
400
200
0
Friday
Saturday
Sunday
12:00 AM
06:00 AM
12:00 PM
06:00 PM
12:00 AM
06:00 AM
12:00 PM
06:00 PM
12:00 AM
06:00 AM
12:00 PM
06:00 PM
Eastbound
Westbound

TABLE 3: Number of Summer Hours of Traffic Activity on SR 267 by Traffic Volume (1/2)

For June 14, 2002 Through September 15, 2002
For Count Location on SR 28 Just East of SR 267 in Kings Beach

Hourly Traffic Volume Between	And	Eastbound			Westbound		
		Number of Hours in Volume Range	Number of Hours with Volume Less Than Upper End of Range	% of Hours With Volume Less Than Upper End of Range	Number of Hours in Volume Range	Number of Hours with Volume Less Than Upper End of Range	% of Hours With Volume Less Than Upper End of Range
0	10	7	7	0.31%	0	0	0.00%
11	20	126	133	5.90%	25	25	1.11%
21	30	115	248	11.00%	78	103	4.57%
31	40	62	310	13.75%	105	208	9.22%
41	50	61	371	16.45%	50	258	11.44%
51	60	60	431	19.11%	50	308	13.66%
61	70	46	477	21.15%	58	366	16.21%
71	80	40	517	22.93%	33	399	17.69%
81	90	17	534	23.68%	55	454	20.13%
91	100	15	549	24.35%	41	495	21.95%
101	110	17	566	25.10%	27	522	23.15%
111	120	13	579	25.68%	18	540	23.93%
121	130	17	596	26.43%	14	554	24.57%
131	140	19	615	27.27%	18	572	25.37%
141	150	12	627	27.81%	10	582	25.81%
151	160	13	640	28.37%	17	599	26.56%
161	170	7	647	28.69%	13	612	27.14%
171	180	13	660	29.27%	13	625	27.72%
181	190	7	667	29.58%	13	638	28.27%
191	200	13	680	30.16%	15	653	28.96%
201	210	5	685	30.38%	18	671	29.76%
211	220	10	695	30.80%	11	682	30.24%
221	230	12	707	31.35%	10	692	30.69%
231	240	21	728	32.28%	8	700	31.02%
241	250	27	755	33.48%	7	707	31.33%
251	260	34	789	34.99%	7	714	31.64%
261	270	29	818	36.25%	8	722	32.00%
271	280	12	830	36.77%	6	728	32.28%
281	290	9	839	37.21%	12	740	32.82%
291	300	4	843	37.38%	12	752	33.35%
301	310	12	855	37.92%	4	756	33.52%
311	320	14	869	38.51%	6	762	33.79%
321	330	9	878	38.91%	11	773	34.28%
331	340	9	887	39.31%	12	785	34.79%
341	350	2	889	39.42%	8	793	35.17%
351	360	7	896	39.70%	18	811	35.97%
361	370	8	904	40.09%	21	832	36.90%
371	380	14	918	40.71%	15	847	37.56%
381	390	12	930	41.24%	13	860	38.11%
391	400	10	940	41.69%	16	876	38.85%
401	410	11	951	42.16%	20	896	39.73%
411	420	12	963	42.71%	17	913	40.47%
421	430	9	972	43.10%	23	936	41.51%
431	440	17	989	43.85%	24	960	42.57%
441	450	15	1,004	44.50%	16	976	43.28%
451	460	22	1,026	45.48%	21	997	44.19%
461	470	10	1,036	45.94%	18	1,015	45.01%
471	480	21	1,057	46.87%	14	1,029	45.61%
481	490	21	1,078	47.81%	9	1,038	46.03%
491	500	11	1,089	48.29%	11	1,049	46.52%
501	510	18	1,107	49.05%	11	1,060	47.01%
511	520	15	1,122	49.76%	16	1,076	47.72%
521	530	21	1,143	50.69%	21	1,097	48.65%
531	540	31	1,174	52.02%	23	1,120	49.67%
541	550	24	1,198	53.08%	37	1,157	51.26%
551	560	26	1,224	54.24%	26	1,183	52.42%
561	570	22	1,246	55.21%	27	1,210	53.61%
571	580	14	1,260	55.85%	30	1,240	54.95%
581	590	15	1,275	56.50%	37	1,277	56.59%
591	600	24	1,299	57.56%	22	1,299	57.56%
601	610	24	1,323	58.63%	28	1,327	58.80%
611	620	19	1,342	59.47%	27	1,354	60.00%
621	630	15	1,357	60.13%	14	1,368	60.62%
631	640	21	1,378	61.06%	20	1,388	61.51%
641	650	20	1,398	61.95%	23	1,411	62.55%

TABLE 3: Number of Summer Hours of Traffic Activity on SR 267 by Traffic Volume (2/2)

For June 14, 2002 Through September 15, 2002
For Count Location on SR 28 Just East of SR 267 in Kings Beach

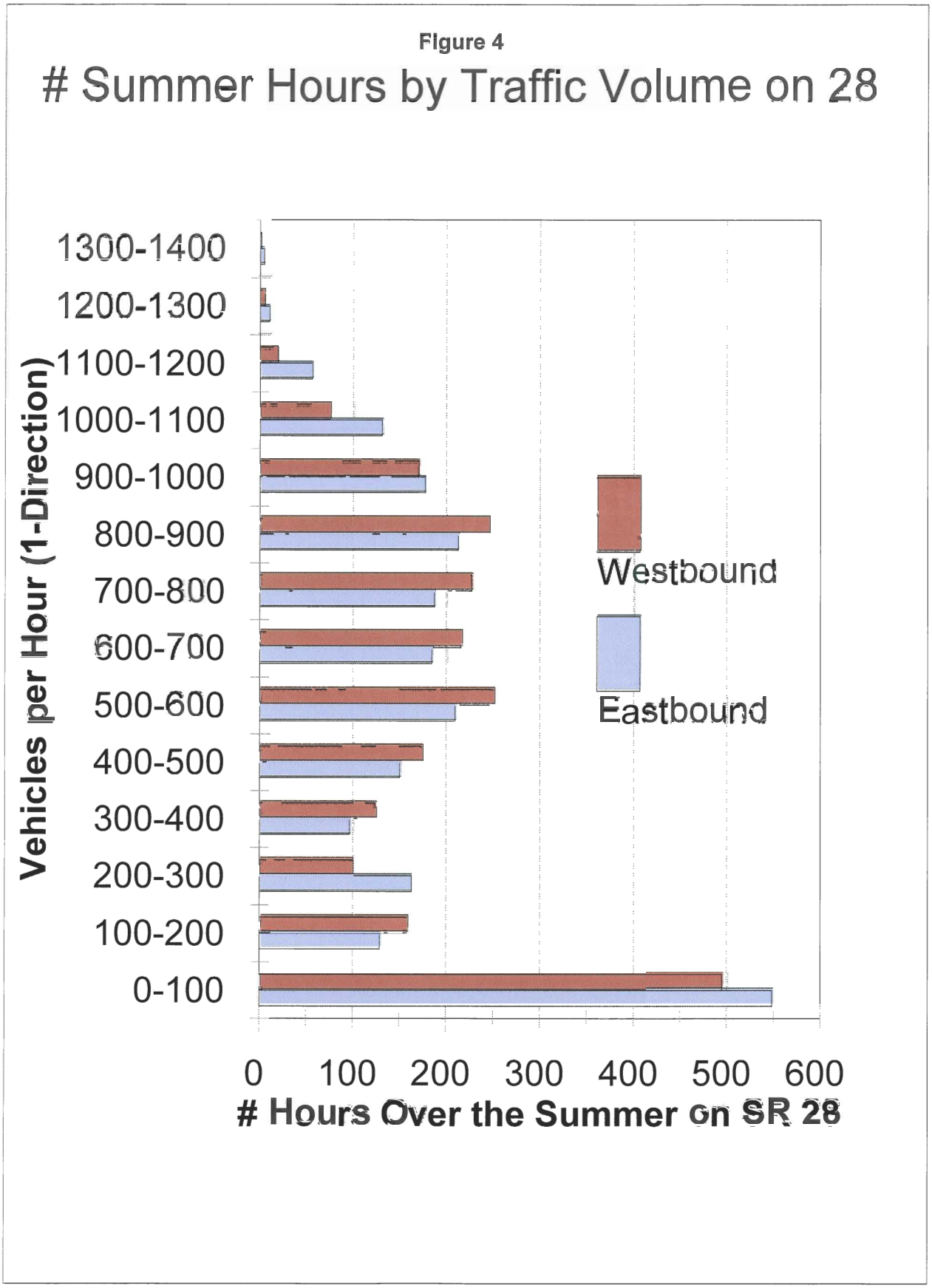
Hourly Traffic Volume Between	And	Eastbound Number of Hours in Volume Range	Eastbound Number of Hours with Volume Less Than Upper End of Range	Eastbound % of Hours With Volume Less Than Upper End of Range	Westbound Number of Hours in Volume Range	Westbound Number of Hours with Volume Less Than Upper End of Range	Westbound % of Hours With Volume Less Than Upper End of Range
651	660	19	1,417	62.79%	14	1,425	63.15%
661	670	19	1,436	63.64%	23	1,448	64.17%
671	680	17	1,453	64.39%	21	1,469	65.12%
681	690	19	1,472	65.23%	26	1,495	66.25%
691	700	14	1,486	65.85%	19	1,514	67.10%
701	710	22	1,508	66.83%	19	1,533	67.94%
711	720	19	1,527	67.67%	19	1,552	68.80%
721	730	21	1,548	68.60%	20	1,572	69.67%
731	740	15	1,563	69.27%	17	1,589	70.42%
741	750	20	1,583	70.18%	20	1,609	71.31%
751	760	14	1,597	70.78%	26	1,635	72.46%
761	770	23	1,620	71.80%	25	1,660	73.57%
771	780	20	1,640	72.68%	21	1,681	74.50%
781	790	11	1,651	73.17%	33	1,714	75.97%
791	800	22	1,673	74.15%	27	1,741	77.16%
801	810	24	1,697	75.23%	18	1,759	77.96%
811	820	23	1,720	76.23%	36	1,795	79.56%
821	830	13	1,733	76.83%	26	1,821	80.71%
831	840	18	1,751	77.61%	23	1,844	81.73%
841	850	22	1,773	78.58%	19	1,863	82.57%
851	860	19	1,792	79.42%	23	1,886	83.59%
861	870	25	1,817	80.53%	23	1,909	84.61%
871	880	19	1,836	81.40%	25	1,934	85.72%
881	890	26	1,862	82.53%	22	1,956	86.70%
891	900	20	1,882	83.42%	30	1,986	88.03%
901	910	14	1,896	84.04%	26	2,012	89.18%
911	920	21	1,917	84.97%	27	2,039	90.38%
921	930	18	1,935	85.77%	21	2,060	91.31%
931	940	20	1,955	86.65%	16	2,076	92.02%
941	950	19	1,974	87.49%	19	2,095	92.86%
951	960	21	1,995	88.43%	12	2,107	93.39%
961	970	19	2,014	89.27%	15	2,122	94.07%
971	980	20	2,034	90.16%	10	2,132	94.50%
981	990	14	2,048	90.78%	14	2,146	95.12%
991	1000	9	2,057	91.18%	10	2,156	95.59%
1001	1010	19	2,076	92.02%	16	2,172	96.28%
1011	1020	16	2,092	92.73%	10	2,182	96.72%
1021	1030	27	2,119	93.93%	8	2,190	97.07%
1031	1040	12	2,131	94.47%	6	2,196	97.34%
1041	1050	6	2,137	94.72%	10	2,206	97.78%
1051	1060	8	2,145	95.08%	4	2,210	97.96%
1061	1070	16	2,161	95.78%	5	2,215	98.20%
1071	1080	10	2,171	96.25%	6	2,221	98.46%
1081	1090	6	2,177	96.50%	3	2,224	98.60%
1091	1100	10	2,187	96.92%	7	2,231	98.90%
1101	1110	6	2,193	97.21%	3	2,234	99.03%
1111	1120	13	2,206	97.78%	4	2,238	99.20%
1121	1130	6	2,212	98.04%	1	2,239	99.23%
1131	1140	6	2,218	98.31%	0	2,239	99.27%
1141	1150	6	2,224	98.60%	2	2,241	99.34%
1151	1160	4	2,228	98.76%	1	2,242	99.38%
1161	1170	1	2,229	98.79%	1	2,243	99.44%
1171	1180	4	2,233	98.97%	1	2,244	99.49%
1181	1190	3	2,236	99.14%	2	2,246	99.58%
1191	1200	6	2,242	99.38%	4	2,250	99.71%
1201	1210	1	2,243	99.44%	1	2,251	99.78%
1211	1220	1	2,244	99.48%	0	2,251	99.79%
1221	1230	2	2,246	99.56%	1	2,252	99.80%
1231	1240	1	2,247	99.59%	0	2,252	99.81%
1241	1250	1	2,248	99.64%	0	2,252	99.83%
1251	1260	0	2,248	99.67%	1	2,253	99.86%
1261	1270	1	2,249	99.70%	1	2,254	99.90%
1271	1280	1	2,250	99.75%	0	2,254	99.93%
1281	1290	1	2,251	99.78%	1	2,255	99.95%
1291	1300	1	2,252	99.83%	0	2,255	99.96%
1301	1310	1	2,253	99.85%	0	2,255	99.98%
1311	1320	0	2,253	99.86%	1	2,256	100.00%
1321	1330	3	2,256	100.00%			

TABLE 4: Number of Summer Hours of Traffic Activity on SR 267 by Traffic Volume In Hundred Increments

For June 14, 2002 Through September 14, 2002
For Count Location on SR 28 Just East of SR 267 in Kings Beach

		Eastbound			Westbound		
Hourly Traffic Volume Between	And	Number of Hours in Volume Range	Number of Hours with Volume Less Than Upper End of Range	% of Hours With Volume Less Than Upper End of Range	Number of Hours in Volume Range	Number of Hours with Volume Less Than Upper End of Range	% of Hours With Volume Less Than Upper End of Range
0	100	548	548	24.29%	495	495	21.95%
100	200	129	677	30.03%	158	653	28.96%
200	300	163	840	37.24%	99	752	33.35%
300	400	96	936	41.51%	124	876	38.85%
400	500	150	1,086	48.14%	173	1,049	46.52%
500	600	209	1,295	57.42%	250	1,299	57.56%
600	700	184	1,479	65.58%	215	1,514	67.10%
700	800	187	1,666	73.87%	227	1,741	77.16%
800	900	212	1,878	83.24%	245	1,986	88.03%
900	1000	177	2,055	91.08%	170	2,156	95.59%
1000	1100	131	2,186	96.89%	75	2,231	98.90%
1100	1200	56	2,242	99.37%	19	2,250	99.71%
1200	1300	10	2,252	99.82%	5	2,255	99.96%
1300	1400	4	2,256	100.00%	1	2,256	100.00%

Figure 4


Summer Hours by Traffic Volume on 28
1300-1400
1200-1300
1100-1200
1000-1100
900-1000
800-900
700-800
600-700
500-600
400-500
300-400
200-300
100-200
0-100
Vehicles per Hour (1-Direction)
Westbound
Eastbound
0
100
200
300
400
500
600
Hours Over the Summer on SR 28

vehicles per hour for a total of five hours (four hours in the eastbound direction and one hour in the westbound direction).

This data can also be evaluated to identify various potential design volume levels, as shown in Table 5. While roadway facilities are typically designed based upon the 30th-highest volumes, other levels of relatively high traffic activity are also provided as a basis for comparison. As indicated, the 30th-highest volumes are roughly 83 percent to 87 percent of the peak observed volumes (for eastbound and westbound directions, respectively).

TABLE 5: Traffic Volume Distribution on SR 28 East of SR 267

Summer, 2002 Caltrans Counts

	Westbound		Eastbound	
Volume Level	Volume	% of Peak	Volume	% of Peak
Peak	1,332	--	1,329	--
10th Highest	1,200	90.09%	1,240	93.30%
30th Highest	1,100	82.58%	1,160	87.28%
100th Highest	1,000	75.08%	1,060	79.76%

Winter 2003 Caltrans Count Data

Data (though for a more limited period) is also available from Caltrans counts for winter conditions on SR 28 east of SR 267. A summary of peak-hour volumes observed for each day in January, 2003 is presented as Table 6. A review of this data indicates that the peak eastbound volumes are comparable to the summer 30th-highest volumes, though peak westbound volumes are substantially lower in winter than in summer.

SR 28 Intersection Summer Turning Movement Volumes

Table 7 presents the most recent available peak season intersection turning movement counts for the public street intersections in the study area. Summer counts were most recently conducted by Caltrans staff in the late 1990's. In addition, a winter count was conducted by LSC staff at SR 28/SR 267 in January, 2003 as part of this study. This winter count reflects peak Saturday traffic when ski traffic into Kings Beach and Incline Village is at its greatest level. Total traffic volumes through the SR 267 / SR 28 intersection during the winter peak hour was 93 percent of the volumes observed during the summer peak hour. In addition, the roadway volume on SR 28 east of SR 267 during this busy winter peak-hour corresponds to the 88th percentile level of

TABLE 6: Winter Peak-Hour Traffic Data

SR 28 East of SR 267

	Day of Week	AM Pk-HR EB	AM Pk-HR WB	PM Pk-HR EB	PM Pk-HR WB
01-Jan-03	WED	735	925	946	893
02-Jan-03	THURS	800	1005	1158	924
03-Jan-03	FRI	664	891	1174	950
04-Jan-03	SAT	573	778	939	752
05-Jan-03	SUN	454	650	748	592
06-Jan-03	MON	527	621	861	704
07-Jan-03	TUES	507	566	945	718
08-Jan-03	WED	488	602	941	670
09-Jan-03	THURS	571	581	821	619
10-Jan-03	FRI	516	538	910	688
11-Jan-03	SAT	562	576	805	565
12-Jan-03	SUN	404	592	593	553
13-Jan-03	MON	484	572	783	663
14-Jan-03	TUES	497	554	868	645
15-Jan-03	WED	487	564	913	678
16-Jan-03	THURS	509	591	943	660
17-Jan-03	FRI	575	624	1124	773
18-Jan-03	SAT	659	624	1050	749
19-Jan-03	SUN	581	781	867	730
20-Jan-03	MON	528	877	863	794
21-Jan-03	TUES	509	566	738	621
22-Jan-03	WED	466	541	821	645
23-Jan-03	THURS	515	518	754	666
24-Jan-03	FRI	540	572	963	717
25-Jan-03	SAT	595	641	940	720
26-Jan-03	SUN	490	666	720	607
27-Jan-03	MON	483	617	709	657
28-Jan-03	TUES	497	534	839	706
29-Jan-03	WED	457	553	769	697
30-Jan-03	THURS	465	562	825	681
31-Jan-03	FRI	563	578	1101	753

Source: Caltrans

TABLE 7: Available Intersection Peak-Hour Traffic Counts

				Southbound			Westbound			Northbound			Eastbound			
SR 28 @	Date	Day of Wk	Hr Beginning	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	TOTAL
Summer																
267	08/19/98	Wednesday	05:00 PM	252	1	196	2	476	298	1	0	2	150	651	1	2,030
Secline	07/31/99	Saturday	12:00 PM	38	2	16	22	979	33	22	1	20	43	1144	11	2,331
Deer	08/21/99	Saturday	11:15 AM	3	0	23	23	1017	21	0	0	4	28	946	12	2,077
Bear	07/10/99	Saturday	03:45 PM	8	0	77	37	827	40	11	0	57	46	814	49	1,966
Coon	NA	NA	NA	111	27	70	32	893	33	31	7	33	69	900	77	2,283
Fox	08/21/99	Saturday	03:00 PM	34	3	42	3	756	60	0	0	0	51	1036	0	1,985
Chipmunk	NA	NA	NA	23	0	14	--	996	18	--	--	--	40	1049	--	2,140
Winter																
267	01/04/03	Saturday	04:30 PM	367	5	209	2	388	261	1	0	1	135	519	0	1,888

Source of Summer Counts: Caltrans District 3

Source of Winter Counts: LSC

summer traffic volumes (as shown in Table 3). As traffic volumes are significantly lower and as other factors (such as pedestrian and bicycle activity) have a lower impact on traffic flow in the winter, it can be concluded that summer is the key traffic design period in the study area.

Using the Caltrans hourly directional counts for SR 28 just east of SR 267, it is possible to adjust these observed counts to reflect a specific summer 2002 design level. For this analysis, a 30th-highest hour design level was applied. A Policy on Geometric Design of Highways and Street (American Association of State Highway and Transportation Officials, 2001) indicates that "*The design hourly volume for rural highways ... should generate by the 30th highest volume of the future year chosen for design.*" (p 61). This traffic level corresponds closely with peak-hour volumes observed on a busy Saturday in August, and will be used as the design volumes for this study.

Specifically, the SR 28/267 volumes shown in Table 7 were adjusted to match the 30th-highest hourly roadway volumes presented in Table 5. Exiting volumes were then balanced against the entering volumes at the next intersection to the east. In addition, PM peak-hour roadway volumes collected by Placer County on SR 28 just east of Fox Street for the period from July 24, 2002 through July 29, 2002 were compared with the Caltrans counts just east of SR 267 for the same period to identify the 30th-highest hourly volumes between Fox and Chipmunk Streets. Intersection volumes were then adjusted to also match these volumes east of Fox Street, reflecting the drop in traffic levels associated with turning movements along SR 28 at private driveways. This impact of driveway traffic between the various intersections was allocated based upon the block-by-block parking demand not served by the public streets. The resulting 30th-highest Summer 2002 intersection turning movements are presented in Table 8.

Traffic Volumes on Local Kings Beach Roadways

In the summer of 2002, Placer County Department of Public Works conducted a series of intersection and road tube traffic counts throughout the county roadway network in Kings Beach. A summary of the intersection peak-hour counts are presented in Table 9, while a summary of the road tube counts are presented in Table 10. Intersection counts were generally conducted over a two-hour period on two different days in June, July or August, while the road tube counts were conducted over a week-long period in late July. In addition, Placer County road tube counts conducted in the late 1990's for Speckled Avenue just east of SR 267 indicate ADT volumes ranging from 461 to 878.

This data (along with the intersection count data along SR 28) was used to plot the peak-hour and the total daily traffic volumes, as shown in Figure 5. A review of this count data indicates the following:

- There is little or no evidence of an existing "cut through" traffic pattern between SR 28 and SR 267, as evidenced in particular by the volumes on Speckled Avenue and Dolly Varden Avenue at SR 267. Traffic volumes are typical for the level of land use development on the internal streets.

TABLE 8: Peak-Hour Summer 2002 Intersection Turning Movement Design Volumes

	Southbound			Westbound			Northbound			Eastbound			
SR 28 @	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	TOTAL
267	323	1	264	3	675	422	1	0	3	202	834	1	2,729
Secline	39	2	17	22	1,055	36	24	1	26	42	1,106	11	2,381
Deer	3	0	24	25	1,054	22	0	0	5	33	1,106	14	2,286
Bear	10	0	91	44	973	47	13	0	73	56	986	59	2,352
Coon	113	27	72	33	922	34	32	7	42	69	903	77	2,331
Fox	36	3	50	3	892	71	0	0	0	48	985	0	2,088
Chipmunk	21	0	13	--	909	16	0	--	0	37	961	0	1,957

TABLE 9: Kings Beach 2002 Summer Peak-Hour Intersection Counts *Conducted by Placer County Staff*

N/S Street	E/W Street	Date	Hr Beg	Southbound			Westbound			Northbound			Eastbound			TOTAL
				LT	T	RT	LT	T	RT	LT	T	RT	LT	T	RT	
SR 267	Dolly Varden	08/07/02	12:00 PM	15	481	0	5	0	15	0	428	3	0	0	0	947
Secline Street	Rainbow Ave	08/06/02	03:00 PM	2	14	1	26	2	2	4	27	30	0	1	5	114
Wolf Street	Dolly Varden	06/27/02	12:30 PM	1	0	4	0	18	0	0	0	0	2	17	0	42
Deer Street	Steelhead St	08/05/02	12:45 PM	5	14	6	3	11	0	5	28	4	6	6	10	98
Bear Street	Golden Ave	06/27/02	03:15 PM	3	29	1	4	4	0	4	48	8	2	7	3	113
Coon Street	Speckled Street	06/25/02	02:30 PM	2	3	4	2	10	0	17	3	1	3	16	10	71
Coon Street	Rainbow Street	06/27/02	01:00 PM	2	52	0	1	6	6	7	39	4	22	8	2	149
Fox Street	Cutthroat Ave	08/07/02	03:00 PM	0	12	0	7	6	2	4	14	8	0	6	1	60
Fox Street	Dolly Varden	07/17/02	11:45 AM	0	14	1	1	3	3	3	19	5	3	1	3	56
Fox Street	Loch Levon	07/17/02	03:00 PM	1	24	1	0	2	3	5	21	7	2	4	2	72
Fox Street	Trout Street	08/05/02	03:00 PM	2	50	0	2	1	1	2	48	10	12	1	2	131

Note: Reported volumes are the higher of those observed on two days of counts, with the exception of Wolf/Dolly Varden that was counted on one day only.

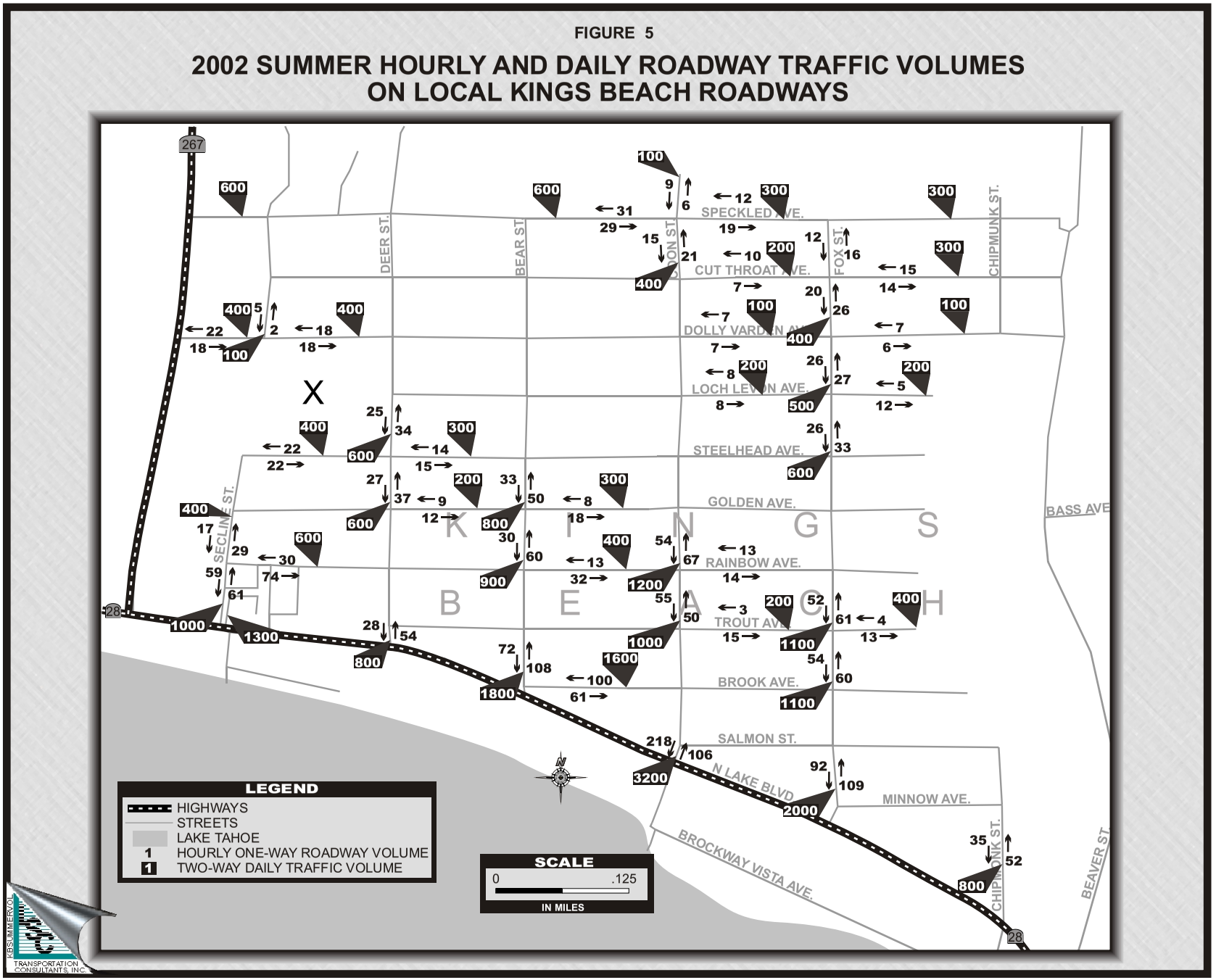
TABLE 10: Placer County DPW Kings Beach 2002 Summer Roadway Volumes

Street	Location	Date	Day	Total Daily		AM Peak Hour		PM Peak Hour	
				WB	EB	WB	EB	WB	EB
SR 28	West of Fox St.	07/24/02	Wed	10,682	--	682	--	860	--
		07/25/02	Thur	10,776	--	730	--	862	--
		07/26/02	Fri	11,534	--	782	--	892	--
		07/27/02	Sat	12,635	--	913	--	966	--
		07/28/02	Sun	12,726	--	1,094	--	1,134	--
		07/29/02	Mon	10,279	--	722	--	810	--
SR 28	East of Fox St	07/24/02	Wed	--	11,102	--	750	--	960
		07/25/02	Thur	--	11,038	--	751	--	954
		07/26/02	Fri	--	12,782	--	794	--	1,043
		07/27/02	Sat	--	13,399	--	950	--	1,101
		07/28/02	Sun	--	11,380	--	844	--	1,009
		07/29/02	Mon	--	10,298	--	712	--	854
Fox St	N of SR 28	07/24/02	Wed	1,143	264	71	32	126	22
		07/25/02	Thur	1,040	220	66	24	122	21
		07/26/02	Fri	1,075	259	62	23	120	20
		07/27/02	Sat	1,122	271	102	23	101	24
		07/28/02	Sun	925	201	63	15	90	23

Source: Placer County DPW

FIGURE 5

2002 SUMMER HOURLY AND DAILY ROADWAY TRAFFIC VOLUMES ON LOCAL KINGS BEACH ROADWAYS



- Not surprisingly, traffic volumes on the local streets are highest near SR 267 and particularly near SR 28. Volumes on north-south streets drop substantially north of the first two blocks off of SR 28.

- Coon Street has the greatest traffic activity of any of the local streets, particularly in the southbound direction. This reflects the relative ease of access to SR 28 provided by the existing traffic signal.

EXISTING PEDESTRIAN / BICYCLE ACTIVITY COUNTS

Table 11 presents a summary of available recent counts of pedestrian and bicycle activity in the Kings Beach area. As these counts were limited to specific days, they may not reflect actual peak levels of activity. In general, however, the data indicates that pedestrian crossing of SR 28 are highest at Bear Street (with the probable exception of Coon Street, for which no data is available), with 144 pedestrians and 1 cyclist crossing the state highway in the peak observed hour.

EXISTING INTERSECTION LEVEL OF SERVICE

The data presented above can be analyzed using the *Highway Capacity Software* programs to identify the existing Level Of Service (LOS) at the various intersections. "LOS" is measured on a scale of LOS A (free-flow conditions with little or no delay) to LOS F (stop-and-go congestion); more detailed descriptions of the individual levels of service are provided in Appendix B.

The TRPA standard is to achieve LOS D or better at signalized intersections, with up to four hours at LOS E allowed. A review of the hourly traffic data presented in Appendix A indicates that six hours exceeding the design volume in both directions on SR 28 on one day (July 5, 2002), and five hours exceeded the design volume westbound on July 6, 2002; as these numbers exceeds the four hours allowed under the TRPA standard, an LOS of D will be used in this study as the standard for summer conditions. TRPA has no standards specific to unsignalized intersections, though intersection approaches with LOS F conditions are typically considered to be a concern by TRPA staff. (Bridget Cornell, TRPA, personal conversation).

As indicated in Table 12, the existing signalized SR 267 / SR 28 intersection operates at an adequate LOS of B in the summer design period, while the SR 28 / Coon Street intersection operates at LOS A. The unsignalized Secline, Bear, Fox and Chipmunk street intersections, however, operate at LOS F for the worst movement (the side street approaches to SR 28), while this worst approach operates at LOS D at Deer Street and LOS E at Chipmunk Street. All Highway Capacity Software outputs for the various LOS calculations are presented in Appendix C.

TRAFFIC SAFETY

Table 13 presents a summary of accident history along SR 28 in Kings Beach for a three-year period (April 1, 1996 through March 30, 1999). Due to the close spacing of intersection, all accidents are considered for the closest intersection. As indicated, a total of 67 intersections were

TABLE 11: Summary of Available Bicycle and Pedestrian Counts Along SR 28 in Kings Beach

					East Side		North Side		West Side		South Side	
SR 28 @	Date	Day of Wk	Hr Beginning	Source	Ped	Bike	Ped	Bike	Ped	Bike	Ped	Bike
267	01/04/03	Saturday	02:15 PM	LSC	6	--	18	--	4	--	1	--
Secline	07/31/99	Saturday	12:00 PM	Caltrans	19	1	1	1	--	--	71	29
Deer	08/21/99	Saturday	11:15 AM	Caltrans	35	--	47	--	23	--	36	--
Bear	07/10/99	Saturday	03:45 PM	Caltrans	44	0	44	19	100	1	20	1
Coon		Saturday	01:00 PM	Caltrans	45	--	--	--	55	--	--	--
Fox	08/21/99	Saturday	03:00 PM	Caltrans	42	4	38	4	2	0	--	--
Bear	06/20/02	Thursday	12:30 PM	Placer Co	Total Crossing 28 In 1/2 Block Either Side of Bear = 130 Pedestrians + 12 Bicyclists							

TABLE 12: Existing (2002) Summer Design Peak-Hour Intersection LOS

SR 28 @	Existing Traffic Control	Worst Approach Delay (s/veh)	Worst Approach LOS	Total Intersection Delay (s/veh)	Total Intersection LOS
SR 267	Signal	—	—	19.6	B
Secline Street (1)	Two-Way Stop Controlled	536.0	F	—	—
Deer Street	Two-Way Stop Controlled	27.5	D	—	—
Bear Street (1)	Two-Way Stop Controlled	169.0	F	—	—
Coon Street	Signal	—	—	8.9	A
Fox Street	Two-Way Stop Controlled	178.7	F	—	—
Chipmunk Street	Two-Way Stop Controlled	41.4	E	—	—

Note 1: Although the none of the minor street southbound approaches are striped with separate right-turn lanes, the southbound approaches to the Secline and Bear intersections are wide and used as if there are separate right-turn lanes. Therefore, the LOS at these two intersections was calculated assuming separate right-turn lanes on the southbound approaches.

KB Summer 02 LOS.wb3

TABLE 13: State Route 28 in Kings Beach Accident Evaluation, 1996-99

SR 28 Intersection	Milepost	Total Accidents		Fatalities		Injuries		Estimated	Accident Rate/MVM		Average California Statewide Rate per MVM (1)			% of Statewide Average	
		Number	Percent	Number	Percent	Number	Percent	MVM	Total	Injury	Total	Injury	Fatality	Total	Injury
Location of Accident															
Junction 267	9.340	12	17.9%	0	0.0%	3	4.5%	24.4	0.49	0.12	0.70	0.32	0.01	70%	39%
Secline Street	9.430	11	16.4%	0	0.0%	3	4.5%	21.3	0.52	0.14	0.22	0.09	0.00	236%	150%
Deer Street	9.585	12	17.9%	0	0.0%	3	4.5%	20.4	0.59	0.15	0.22	0.09	0.00	268%	157%
Bear Street and Brook Street	9.720	6	9.0%	0	0.0%	0	0.0%	21	0.29	0.00	0.33	0.15	0.01	88%	0%
Coon Street	9.880	9	13.4%	0	0.0%	1	1.5%	20.8	0.43	0.05	0.70	0.32	0.01	61%	15%
Fox Street	10.025	7	10.4%	0	0.0%	2	3.0%	18.7	0.37	0.11	0.22	0.09	0.00	168%	114%
Chipmunk Street	10.215	7	10.4%	0	0.0%	2	3.0%	17.5	0.40	0.11	0.22	0.09	0.00	182%	122%
Beaver Street	10.263	3	4.5%	0	0.0%	0	0.0%	17.2	0.17	0.00	0.22	0.09	0.00	77%	0%
3-Year Total		*67*	*100.0%*	*0*	*0.0%*	*14*	*20.9%*								
Year of Accident															
1996 (Apr - Dec)	–	16	23.9%	0	0.0%	1	1.5%								
1997	–	24	35.8%	0	0.0%	6	9.0%								
1998	–	22	32.8%	0	0.0%	6	9.0%								
1999 (Jan - Mar)	–	5	7.5%	0	0.0%	1	1.5%								
3-Year Total	–	*67*	*100.0%*	*0*	*0.0%*	*14*	*20.9%*								
Type of Collision															
Head-On	–	2	3.0%	0	0.0%	2	3.0%								
Sideswipe	–	10	14.9%	0	0.0%	1	1.5%								
Rear-End	–	15	22.4%	0	0.0%	3	4.5%								
Broadside	–	25	37.3%	0	0.0%	3	4.5%								
Hit Object	–	9	13.4%	0	0.0%	2	3.0%								
Auto/Pedestrian	–	2	3.0%	0	0.0%	2	3.0%								
Other	–	4	6.0%	0	0.0%	1	1.5%								
3-Year Total	–	*67*	*100.0%*	*0*	*0.0%*	*14*	*20.9%*								

MVM = Million Vehicle Movements through the intersection

Source: Caltrans District 3 TASAS Table B Accident Records, (April 1, 1996 through March 31, 1999), and "2000 Accident Data on California State Highways (Caltrans).

recorded over this period, of which 14 resulted in injuries, none resulted in fatalities, and the remainder resulted in property damage only. Accidents were concentrated in the western end of the study area, with 12 accidents each at the SR 28 / SR 267 intersection and the SR 28 / Deer Street intersection, and 11 accidents at the SR 28 / Secline intersection. By type, the largest proportion were broadside accidents (25), which is a relatively hazardous type of accident, followed by rear-end accidents (15) and sideswipes (10). Two pedestrian accidents were recorded, and no bicycle accidents.

By dividing the number of accidents by the estimated total Million Vehicle Movements (MVM) over the data period, the accident rate per MVM can be calculated. As shown, this rate is relatively high for the SR 28 / Secline and SR 28 / Deer intersections. Finally, these rates can be compared against California statewide averages for similar types of intersections in rural areas, as presented in *2000 Accident Data on California State Highways* (Caltrans, 2001). As indicated in the right-most portion of the table, the two signalized intersections at SR 28 / SR 267 and at SR 28 / Coon Street had relatively low rates, at 30 percent and 39 percent the statewide average, respectively. However, accident rates (both total and injury) exceed the statewide average at the SR 28 intersections with Secline Street, Deer Street, Fox Street, and Chipmunk Street. In particular the total rate at the Secline Street and Deer Street intersections exceed the statewide average by more than a factor of two. While some of this increased rate can be attributed to snow conditions (as the majority of intersections statewide are below the snow line), the greater factors are probably excessive speeding and the difficulties of judging an acceptable gap in traffic on a four-lane roadway in high volume conditions.

Chapter 3
Future Traffic Conditions

As is standard practice for environmental impact documentation, future traffic conditions are evaluated for the first year that the potential roadway modifications could be in place (2008), and for twenty years beyond this first year (2028).

EVALUATION OF 2008 TRANSPORTATION CONDITIONS

Traffic volumes for this analysis are estimated by factoring existing volumes by current trends in traffic volumes. No growth in north/south street traffic is assumed (as future land use growth within Kings Beach will be largely constrained by TRPA development controls). At the time of preparation of this report, decisions regarding parking lot locations are not finalized; therefore no adjustments have been made to reflect the traffic impacts associated with new parking facilities. However, the segment of Brook Avenue from Bear Street to Coon Street would need to be converted to one-way eastbound operation, in order for either the signal or roundabout at the Bear/SR 28 intersection to operate; this modification is therefore assumed.

As shown in Table 1, peak-month average daily traffic volumes increased by an average of 0.31 percent per year on SR 28 east of SR 267 between 1992 and 2002, and increased by an average of 0.70 percent per year of SR 267 north of SR 28. These growth rates were applied to the existing directional link design volumes for the six years between the 2002 counts and the 2008 design year, which indicated that one-way traffic volumes on SR 28 east of SR 267 will increase by 20 vehicles per hour over this period, while one-way traffic volumes on SR 267 north of SR 28 will increase by 25 vehicles per hour. These increases were used to adjust traffic volumes through the study area, assuming none of this increase is "lost" at other study area intersections. In addition, the impacts of the conversion of Brook Street to one-way were used to adjust the intersection turning movement figures, based on existing turning movement patterns. Finally, traffic was shifted from southbound Coon Street to southbound Bear Street to reflect the improvement in access onto SR 28 associated with either a signal or roundabout at Bear Street.

The resulting 2008 design volumes are presented in Table 14. Comparing these figures with the existing design figures shown in Table 8 indicates that total intersection volumes will increase from 1.5 percent to 4.3 percent between 2002 and 2008 (depending upon the specific intersection). Please note that these traffic volume estimates do not reflect diversion of traffic that may occur from traffic delays at intersections or along roadway segments. In addition, these volumes do not reflect the trip generation that may result from the addition of any major new off street parking areas.

Four-Lane / Signalized Alternative

Intersection LOS

The traffic volumes presented in Table 14 were analyzed were analyzed using Highway Capacity Manual methodologies, as presented in the Highway Capacity Software package. The results of

TABLE 14: Peak-Hour Summer 2008 Intersection Turning Movement Design Volumes

	Southbound			Westbound			Northbound			Eastbound			
SR 28 @	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	TOTAL
267	343	1	269	3	675	442	1	0	3	202	834	1	2,774
Secline	39	2	17	22	1075	36	24	1	26	42	1126	11	2,421
Deer	3	0	24	25	1074	22	0	0	5	33	1126	14	2,326
Bear	45	4	72	40	1023	62	13	0	73	68	994	59	2,453
Coon	78	27	87	33	957	19	32	7	42	57	958	77	2,374
Fox	36	3	50	3	912	71	0	0	0	48	1005	0	2,128
Chipmunk	21	0	13	0	929	16	0	0	0	37	981	0	1,997

this analysis is presented in Table 15. As indicated, the traffic signal at SR 28 / SR 267 would operate at LOS C, while the signals at Bear and Coon Streets would operated at LOS A. While the worst approach at the unsignalized Deer Street and Chipmunk Street intersections would operate at LOS E, the other unsignalized intersections would have movements (side-street left-turn movements) that operate at LOS F. Note that this analysis assumes the provision of the eastbound and westbound left-turn phase at the SR 267/SR 28 intersection, as currently planned by Caltrans.

Roadway LOS

To analyze roadway LOS under this roadway configuration, the Highway Capacity Manual methodology for urban arterials was applied. Under this methodology, LOS is a measure of total travel speed through the corridor. For the design period in the peak direction, LOS B was found for 2008 conditions in the peak direction, the a travel speed of 28.3 miles per hour.

Three-Lane / Roundabouts Alternative

Intersection LOS

Intersection LOS was calculated using the Highway Capacity Software package for signalized and unsignalized intersections, while roundabout analysis was conducted using the RODEL software package. (Note that Caltrans *Design Information Bulletin 80*, which provides guidance regarding roundabout design and analysis, identifies this software as one of two acceptable options for analysis of a roundabout.) The results of this LOS analysis are presented in Table 16. As indicated, unsignalized intersections operate with a worst-approach LOS of F, except for the Deer Street intersection that provides a worst-approach LOS of E. LOS and delay levels at these unsignalized intersections are substantially worse with the three-lane roadway configuration than with the four-lane configuration, though traffic volumes are equivalent. This is due to the fact that accommodating all the SR 28 through volumes in a single lane in each direction provides less gaps in traffic to allow movements out of the side streets than with two through lanes in each direction. For instance, average delay for traffic entering SR 28 from Deer Street with the three-lane cross-section (47.5 seconds) would be slightly more than twice the delay with a four-lane cross-section (22.6 seconds).

The roundabouts at all three locations (SR 267, Bear and Coon) are forecast to operate at LOS A, both for the roundabout as a whole and for the worst approach. The SR 28 / SR 267 has been evaluated with an outside diameter of 36 meters (118 feet). The roundabouts at Bear and Coon were evaluated with an outside diameter of 30 meters (98 feet).

Roadway Level of Service

Roadway Segment Capacity

There is no standard analysis technique regarding the capacity associated with urban three-lane roadways operating under congested conditions with heavy parking, pedestrian and bicycle activity. It is therefore necessary to "calibrate" the capacity of a three-lane cross-section in Kings Beach against the observed capacity of a similar cross-section in Tahoe City. LSC staff

TABLE 15: 2008 Four-Lane Alternative Peak-Hour Intersection LOS

		No Project LOS			
		Worst Approach		Total Intersection	
SR 28 @	Existing Traffic Control	Delay (s/veh)	LOS	Delay (s/veh)	LOS
SR 267	Signal	—	—	24.1	C
Secline Street	Two-Way Stop Controlled	600.3	F	—	—
Deer Street	Two-Way Stop Controlled	22.6	E	—	—
Bear Street	Signal	—	—	7.5	A
Coon Street	Signal	—	—	8.0	A
Fox Street	Two-Way Stop Controlled	122.1	F	—	—
Chipmunk Street	Two-Way Stop Controlled	41.7	E	—	—

Note 1: Although the none of the minor street southbound approaches are striped with separate right-turn lanes, the southbound approaches to the Secline and Bear intersections are wide and used as if there are separate right-turn lanes. Therefore, the LOS at these two intersections was calculated assuming separate right-turn lanes on the southbound approaches.

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TABLE 16: 2008 Three-Lane Alternative Peak-Hour Intersection LOS

SR 28 @	Existing Traffic Control	No Project LOS: Worst Approach Delay (s/veh)	Worst Approach LOS	Total Intersection Delay (s/veh)	Total Intersection LOS
SR 267	Roundabout	7.2	A	3.6	A
Secline Street (1)	Two-Way Stop Controlled	(2)	F	—	—
Deer Street	Two-Way Stop Controlled	47.5	E	—	—
Bear Street	Roundabout	6.0	A	5.3	A
Coon Street	Roundabout	6.6	A	4.1	A
Fox Street	Two-Way Stop Controlled	431.5	F	—	—
Chipmunk Street	Two-Way Stop Controlled	91.6	F	—	—

Note 1: Although the none of the minor street southbound approaches are striped with separate right-turn lanes, the southbound approaches to the Secline and Bear intersections are wide and used as if there are separate right-turn lanes. Therefore, the LOS at these two intersections was calculated assuming separate right-turn lanes on the southbound approaches.

Note 2: Delay level too high to calculate

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conducted manual traffic counts on SR 28 in Tahoe City in the summer of 2002, taken just east of the State Recreation Area on the east side of town, as follows:

Observed Capacity (Vehicles per Hour)	EB	WB
Friday, July 12, 2002 - Starting 2:15 PM	822	698
Friday, August 9, 2002 - Starting 12:45 PM	709	741

Both counts were conducted when there was a stop-and-go queue formed by traffic coming into Tahoe City from the east. While capacity varies with the level of pedestrian, bicycling and parking activity, for typical levels of activity on SR 28 in Tahoe City this data indicates a westbound capacity entering Tahoe City of 730 and an eastbound capacity exiting Tahoe City of 750.

These figures are far below (less than half) of the theoretical capacity of a two lane roadway. The traffic engineering profession has not developed standard methods for assessing capacity along a congested recreational roadway such as SR 28 in Tahoe City or Kings Beach. It is therefore necessary to assess the impact of a variety of observed factors in Tahoe City that reduce capacity and then to adjust these figures to reflect the differing level of various factor impacting traffic capacity along SR 28 in Kings Beach versus Tahoe City. These factors are discussed below, and presented in Table 17:

- **Driver characteristics** impact traffic flow. Recreational drivers tend to drive more erratically than commuters (for instance) and are more distracted by sights along the way. As a result, a "base" figure of 1,500 vehicles per hour per lane is appropriate (rather than the maximum value of 1,900 observed in other settings).

- **Pedestrians crossing the highway** require a portion of the time otherwise available for traffic movement. Counts conducted during busy summer conditions in Tahoe City indicate that 16.2 percent of total potential roadway capacity is eliminated due to this factor.

- Similarly **bicyclists crossing the highway** are estimated to reduce capacity in Tahoe City by 2.8 percent.

- **Bicyclists** traveling along the travel lanes also tend to reduce roadway capacity, by causing drivers to hesitate or divert their travel path. This factor is estimated to reduce capacity in Tahoe City by 3 percent.

- **On-street parking maneuvers** impact roadway capacity, as a function of the number of spaces, the turnover rate of the spaces, and the time that traffic is interrupted as drivers enter and exit the spaces. Based on counts and observations made during peak summer conditions, this factor is estimated to reduce capacity in Tahoe City by 6.3 percent.

- **Searching for available on-street parking spaces** reduces capacity, as drivers tend to drive slower than otherwise, in order to avoid missing an available space. Counts conducted in

TABLE 17: Capacity Analysis of 3-Lane SR 28 in Kings Beach

	Observed Conditions: Tahoe City WB	Forecast Conditions: Kings Beach					
		Deer - Bear EB	Bear - Coon EB	Coon - Fox EB	Fox -Coon WB	Coon - Bear WB	Bear - Deer WB
Ideal Capacity (At 25 mph)	*1,500*	1,500	1,500	1,500	1,500	1,500	1,500
Reductions in Capacity							
Pedestrian Crossing							
# Pedestrian Crossings/Hour	*167*	58	144	48	100	144	62
Pedestrians per Group	*2*	2	2	2	2	2	2
# Pedestrian Groups per Hour	*83*	29	72	24	50	72	31
Time Lost per Crossing (sec)	*7*	5	5	7	5	5	7
Total Time Lost per Hour (sec)	*583*	145	360	168	250	360	217
% Time Lost per Hour	*16.2%*	4.0%	10.0%	4.7%	6.9%	10.0%	6.0%
Bicycle Crossing							
# Bicycle Crossings/Hour	*25*	2	2	4	2	2	0
Time Lost per Crossing (sec)	*4*	2	2	2	2	2	2
Total Time Lost per Hour (sec)	*100*	4	4	8	4	4	0
% Time Lost per Hour	*2.8%*	0.1%	0.1%	0.2%	0.1%	0.1%	0.0%
Bicycle Side Friction							
# Bicycles per Hour	*35*	5	5	5	20	20	20
% Time Lost per Hour	*3.0%*	0.4%	0.4%	0.4%	1.7%	1.7%	1.7%
Onstreet Parking Movements							
# Onstreet Spaces	*25*	16	17	6	11	8	11
Average Parking Duration	*1*	1	1	1	1	1	1
Entering Movements / Hour	*25*	16	17	6	11	8	11
Exiting Movements / Hour	*25*	16	17	6	11	8	11
Time Lost per Entering Mvmt (sec)	*7*	7	7	7	7	7	7
Time Lost per Exiting Mvmt (sec)	*2*	2	2	2	2	2	2
Total Time Lost per Hour (sec)	*225*	144	153	54	99	72	99
% Time Lost per Hour	*6.3%*	4.0%	4.3%	1.5%	2.8%	2.0%	2.8%
Parking Space Searching							
% of Entering Traffic Searching for Parking Along Roadway	*24%*	15%	15%	15%	15%	15%	15%
Resulting Impact of Parking Traffic Moving at 20 mph	*21.0%*	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%
Conflicting Driveway Turning Movements							
Number of Driveways	*8*	4	0	8	5	6	5
% Time Lost per Hour	*15.0%*	7.5%	0.0%	15.0%	9.4%	11.3%	9.4%
Truck Loading/Unloading							
% Time Lost per Hour	*2.0%*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Multiplicative Reduction in Capacity	*51.2%*	33.0%	32.3%	37.4%	36.4%	39.3%	35.7%
Resulting Roadway Capacity	*731*	1,004	1,016	940	954	910	964
Calculation of Value at Count Station East of SR 267 Corresponding to Capacity at Each Location							
Existing Count On Segment		1,114	1,112	1,078	1,009	1,125	1,121
Existing Count - Just E of 267		1,160	1,160	1,160	1,120	1,120	1,120
Equivalent Capacity Just E of 267		1,050	1,064	1,022	1,065	905	963

Tahoe City indicate that 24 percent of all traffic entering on SR 28 is destined to the commercial core area. These drivers searching for parking tend to travel at approximately 20 miles per hour, which results in the entire traffic queue traveling at this speed under queued conditions. The *Highway Capacity Manual* indicates that the capacity of a roadway at 20 miles per hour is 21 percent below the capacity at 25 miles per hour.

- **Conflicting turning movements** also tend to reduce roadway capacity, as through drivers are delayed by left-turning drivers who do not fully pull into the center two-way left-turn lane, by right-turning drivers blocked by pedestrians or cyclists crossing the driveway, and by drivers entering the roadway that "force" their way into the traffic stream. Delays are often observed under queue conditions as through drivers politely wave drivers waiting on the side-street into the traffic stream. This factor is estimated in Tahoe City to consume 15 percent of roadway capacity.

- Finally, in Tahoe City **truck loading and unloading activity** occurring in the center two-way left-turn lane sometimes causes additional delays (particularly from beer trucks and other delivery trucks that are accessed on the side rather than the rear). This factor is estimated to result in a final reduction of 2 percent of capacity.

These various factors can be combined in a multiplicative fashion ((1 - Factor A) X (1 - Factor B) X (1 - Factor C), etc). As shown in the bottom of Table 17, these factors together are estimated to reduce westbound roadway capacity in Tahoe City by 51.2 percent. Applying this reduction to the "ideal" capacity of 1,500 vehicles per hour results in a capacity of 732, which calibrates well with the observed westbound capacity of 730.

Fortunately, the capacity reduction impacts of many of these factors would be less in Kings Beach with a three-lane roadway than they are in Tahoe City. The lower levels of bicycle and pedestrian activity in Kings Beach result in lower capacity reductions than in Tahoe City. In addition, the presence of the mid-street splitter island at the approaches to the roundabouts would reduce the length of time that pedestrian crossings would block traffic movement. Similarly, the lower number of on-street parking spaces that would be available along each roadway segment results in less associated loss of capacity. For many roadway segments, the number of driveways is lower than in Tahoe City, resulting in a lower potential for turning-movement conflicts and associated loss in capacity. In addition, it can be expected that the higher number of side-street truck loading opportunities in Kings Beach would avoid the impact of loading activity found in Tahoe City. However, while the proportion of total traffic looking for parking is estimated (based on turning movement volumes) to be lower in Kings Beach, it is still sufficient enough to reduce the overall speed of the traffic queue.

The impacts of these various factors was estimated for the three potential constraining roadway segments in Kings Beach between Deer and Bear, between Bear and Coon, and between Coon and Fox, in each direction, and multiplied by the ideal capacity of 1,500 vehicles per hour per lane. As shown in Table 17, one-way roadway capacity under the three-lane scenario is estimated to range from a low of 910 vehicles per hour for the segment between Coon and Bear Streets westbound to a high of 1,016 for the segment between Bear and Coon Streets eastbound.

The factors having the greatest impacts on roadway capacity in Kings Beach are drivers searching for on-street parking spaces, conflicts with driveway turning movements, and pedestrians crossing the highway. Eastbound travel tends to have a higher capacity than westbound travel, due to the higher number of driveways on the north side of the highway adjacent to the westbound travel lane. In the eastbound direction, the lowest capacity would be provided by the segment between Coon and Fox, largely due to the high number of driveways along this segment. Westbound, the critical segment is between Coon and Bear, due in large part to the high number of pedestrian crossings.

Capacity Versus Roadway Traffic Volumes

To compare capacity versus forecast volumes, it is necessary to determine the volume at the count station on SR 28 just east of SR 267 that corresponds to the capacity figure for each individual analysis segment. This was done by factoring the capacity figure by the ratio of existing peak-hour traffic volume at the count station over the existing peak-hour traffic volume on each analysis segment. For instance, for the westbound segment between Coon and Bear, the existing design volume is 1,129 vehicles per hour while the existing design volume at the count station between Secline and SR 267 is 1,120. Factoring the westbound Coon-Bear capacity (910) by the ratio of these figures (1,120 / 1,129) indicates that roadway capacity westbound between Coon and Bear would be exceeded when the westbound volume at the count station exceeds 905. As shown in the bottom portion of Table 17, this indicates that capacity would be exceeded on one or more segments at a count station traffic level of 905 vehicles per hour in the westbound direction or 1,022 vehicles per hour in the eastbound direction.

Next, the 2008 volumes at the count location (by direction and by hour throughout the summer) can be calculated. Comparing the traffic volumes just east of the SR 267 / SR 28 intersection shown in Table 14 for 2008 with those shown in Table 8 for 2002 indicates that volumes at this location will grow by 1.7 percent in the eastbound direction, and 1.8 percent westbound. These figures were used to factor the 2002 observed hourly volumes presented in Appendix A to yield the estimated hourly volumes for 2008 presented in Appendix D.

The forecast 2008 volumes can be compared on an hour-by-hour basis with the capacity of the 3-lane roadways and a running total calculated of the number of vehicles that could not be accommodated by the minimum roadway capacity in each hour. Figure 6 presents an example of this process, for a typical August Saturday. As shown, traffic volumes are forecast to exceed the roadway capacity starting in the 11 AM hour and ending in the 3 PM hour. Assuming that no traffic diverts to other travel routes (such as through the Kings Beach residential streets), to other travel modes (such as pedestrian and bicycle travel) or to travel in other times of day (before or after the period of congestion), the vehicles not accommodated in any one hour would form a queue that would grow so long as the volume exceeds capacity. This queue would then dissolve based on the available roadway capacity in subsequent hours. A graphic of the queue length associated with this same August Saturday is presented in Figure 7. As indicated, queues grow as long as volume exceeds capacity, and then several hours are required for the accumulated queue to be accommodated by available roadway capacity.

Figure 6

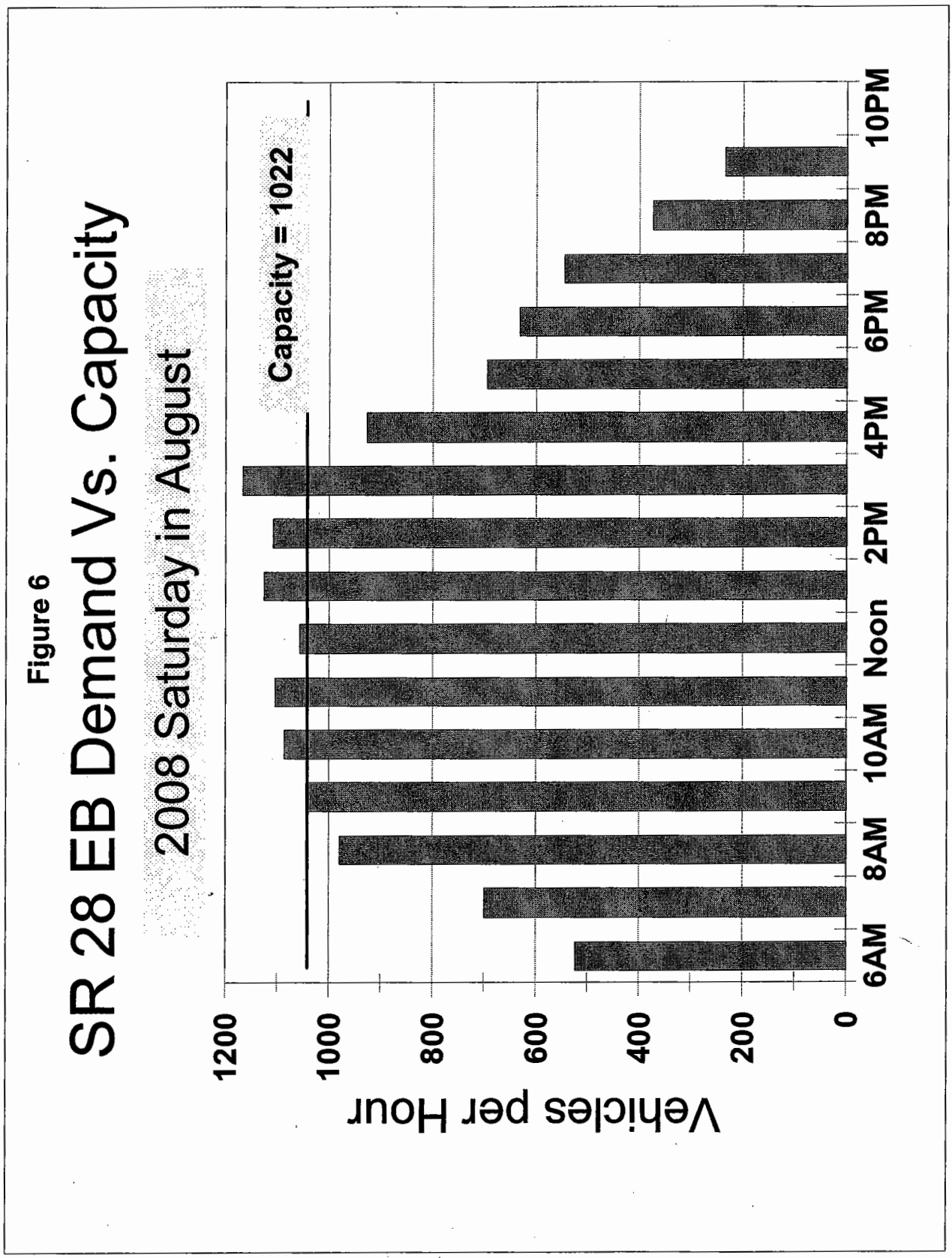
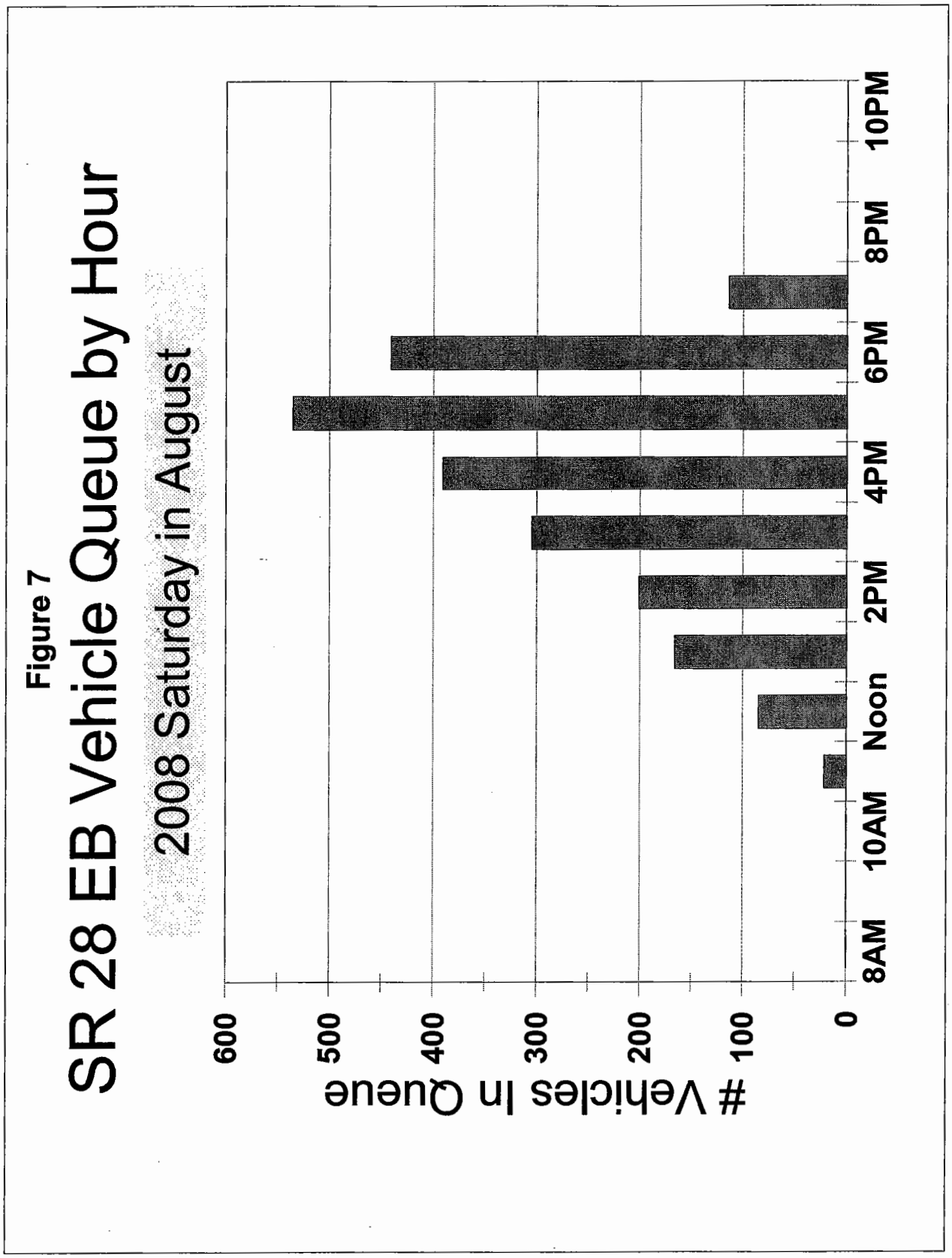

SR 28 EB Demand Vs. Capacity
2008 Saturday in August
Capacity = 1022
Vehicles per Hour
1200
1000
800
600
400
200
0
6AM
8AM
10AM
Noon
2PM
4PM
6PM
8PM
10PM

Figure 7


SR 28 EB Vehicle Queue by Hour
2008 Saturday in August
Vehicles In Queue
600
500
400
300
200
100
0
8AM
10AM
Noon
2PM
4PM
6PM
8PM
10PM

In reality, however, drivers faced with this level of traffic congestion will change their travel patterns. Observations in other similar areas (such as Tahoe City) indicates the following:

- The first strategy that drivers will employ will be to shift their travel route to avoid the congestion. In the case of the Kings Beach area, this would result in very significant diversions in traffic off of SR 28 and on to the residential streets to the north. As there is not an alternate route between Incline Village and points to the west (such as Truckee, Tahoe City, or the Bay Area) short of a long trip through Reno via Mount Rose Highway or through South Lake Tahoe, there is little potential for traffic reductions in the Kings Beach area associated with diversion to other regional highways.

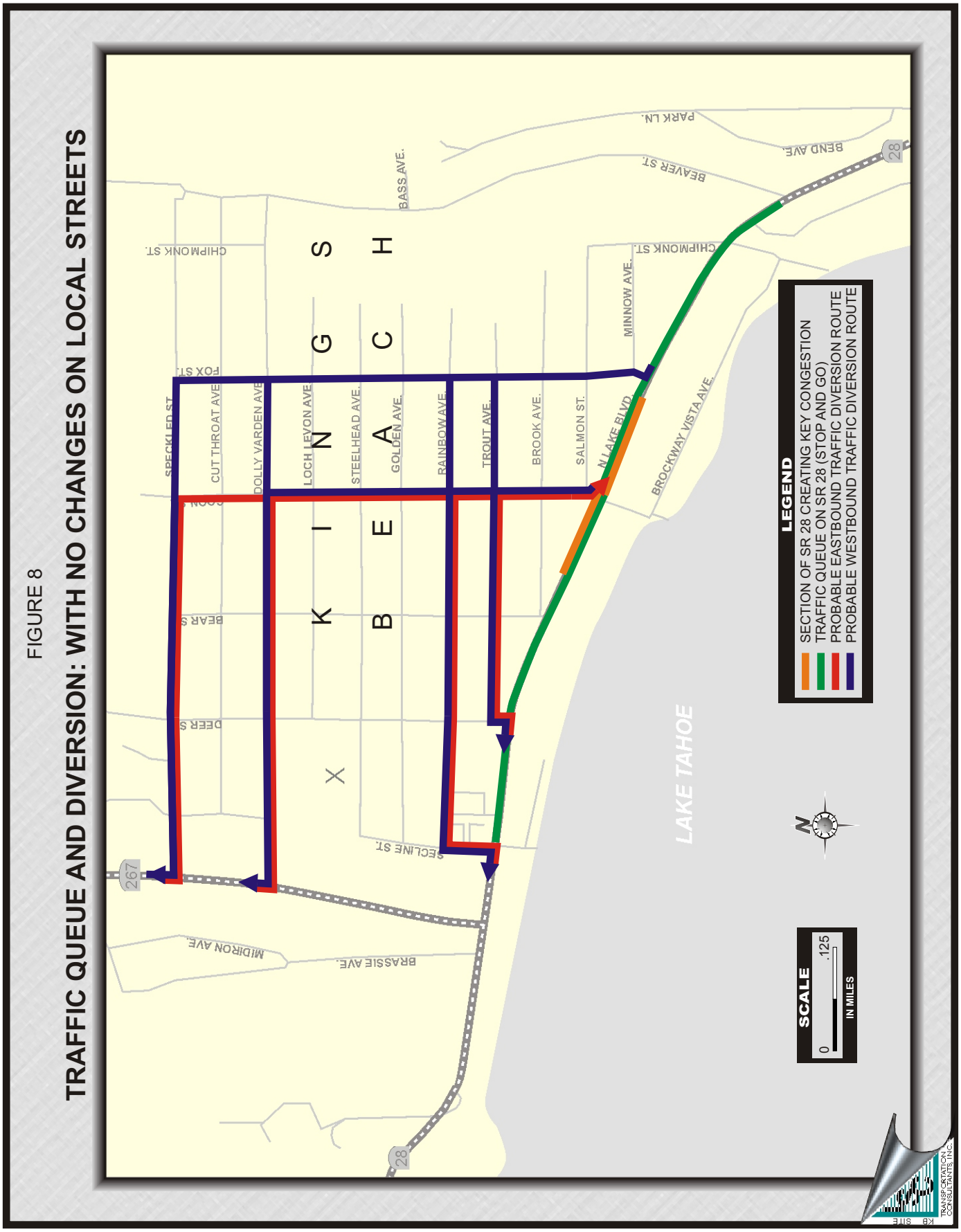
- If alternative routes are not available, or if congestion builds beyond the location where the alternative route is accessible, drivers will next change their time of travel to avoid the periods of congestion (traveling either before after the typical time of congestion) or to change their travel path (use an alternate route).

- Finally, there is a smaller potential for drivers to divert to other travel modes, though the fact that transit buses would be caught in the same traffic delays as all other traffic would negate any benefit of shifting to public transit, while the large majority of drivers typically will not shift to walking or bicycling for trips other than in the immediate Kings Beach area.

As the residential streets provide alternate travel routes that would avoid the capacity constraint sections of SR 28 between Bear Street and Fox Street, it is expected that the large majority of drivers faced with congestion will choose to divert their travel route. As a check, the traffic volume for the westbound-to-northbound movement at the SR 28 / SR 267 intersection (shown in Table 14) was compared with the excess westbound traffic volume over the westbound capacity, and the southbound-to-eastbound movement at this intersection compared with the excess eastbound traffic volume over the eastbound capacity. This comparison indicates that there is more than an adequate number for motorists making these movements to divert SR 28 traffic into the neighborhood streets to bring the traffic volume remaining on the highway down to the capacity levels. It can therefore be expected that traffic congestion on the highway will grow to roughly 3 to 5 minutes (i.e., providing enough of a delay to provide a time savings for drivers diverting into the residential streets), and then drivers will divert off of the highway to a degree that limits (but does not eliminate) traffic delays on SR 28 and SR 267.

Figure 8 presents a map of this diversion pattern. As shown, the block of SR 28 from Coon to Bear Streets in the westbound direction and from Coon to Fox Streets in the eastbound direction are forecast to be the first segments to reach capacity as traffic volumes grow. Traffic will then start to form queues back from these areas along SR 28 for several blocks, until drivers in the queue decide that diverting onto the local streets would provide a shorter travel time than simply waiting in the queue:

- In the westbound direction, the majority of this queuing activity can be expected to travel via Coon Street, Fox Street, Dolly Varden Avenue and Specked Avenue to SR 267 northbound, and via Trout Avenue and Rainbow Avenue for drivers traveling to SR 28 east of SR 267.


TRAFFIC QUEUE AND DIVERSION: WITH NO CHANGES ON LOCAL STREETS
FIGURE 8
KINGS BEACH
LAKE TAHOE
LEGEND
SECTION OF SR 28 CREATING KEY CONGESTION
TRAFFIC QUEUE ON SR 28 (STOP AND GO)
PROBABLE EASTBOUND TRAFFIC DIVERSION ROUTE
PROBABLE WESTBOUND TRAFFIC DIVERSION ROUTE
SCALE
0
.125
IN MILES
N
28
267
CHIPMONK ST.
BASS AVE.
BEAVER ST.
PARK LN.
BEND AVE.
FOX ST.
SPECKLED ST.
CUT THROAT AVE.
DOLLY VARDEN AVE.
LOCH LEVON AVE.
STEELHEAD AVE.
GOLDEN AVE.
RAINBOW AVE.
TROUT AVE.
BROOK AVE.
SALMON ST.
N LAKE BLVD.
MINNOW AVE.
BROCKWAY VISTA AVE.
BEAR ST.
DEER ST.
SECLINE ST.
MIDIRON AVE.
BRASSIE AVE.
TRANSPORTATION CONSULTANTS, INC.

- In the eastbound direction, southbound drivers on SR 267 that are expecting traffic congestion will divert onto Speckled Avenue and Dolly Varden Avenue to Coon Street, where the roundabout would provide good access onto SR 28 eastbound. Eastbound traffic entering Kings Beach on SR 28 would largely divert via Secline Street, Deer Street, Rainbow Avenue, Trout Avenue and Coon Street, again using the Coon Street roundabout to enter SR 28 eastbound.

This analysis was conducted for every day of the forecast Summer 2008 conditions, in both directions. In total this analysis indicates that traffic congestion and queuing would occur on a frequent basis in both directions. Table 18 presents a summary of the traffic queuing conditions that are forecast to occur in 2008 with a three-lane cross-section on SR 28. A review of this table indicates the following:

- Traffic queuing will occur for at least one hour in the eastbound direction on 56 days, and in the westbound direction on 72 days. Queuing will occur for at least one hour in both directions for 54 of these days.

- Over the course of the summer, queues will form for a total of 191 hours in the eastbound direction and 302 hours in the westbound direction. Of these totals, queues will form in both directions at the same time during 172 hours, in the eastbound direction only during 19 hours, and in the westbound direction only during 111 hours.

- Considering only the peak month of August, the average daily hours of traffic queues will be highest on Saturdays, with 5.2 hours of queues in the eastbound direction and 7.2 hours of queues in the westbound direction.

- The maximum number of queuing on any one day will be 8 hours in the eastbound direction and 10 hours in the westbound direction, and will occur around the 4th of July holiday.

- The middle portion of Table 18 presents a distribution of the number of hours per summer that would have varying number of hours of queuing, by direction. This also reflects the higher level of queuing in the westbound direction than in the eastbound direction. For instance, four or more hours of queuing would occur on 40 days in the westbound direction versus 22 days in the eastbound direction.

- The bottom portion presents a summary of the level of diverted traffic that would use the residential streets, by the number of hours the traffic level would occur over the course of the summer. For instance, in the westbound direction, 101 to 200 vehicles per hour would divert on 82 hours, 201 to 300 vehicles per hour would divert on 22 hours, 301 to 400 vehicles per hour would divert on 9 hours, and over 400 vehicles per hour would divert on 2 hours.

Presenting some of this information in a different format, Table 19 presents a "calendar" of the number of hours of traffic queues that can be expected in both directions over the course of the summer of 2008. This indicates that at least some level of westbound queues would form every day from roughly June 27th through August 27th, while eastbound queues would be more sporadic outside of the mid-August period.

TABLE 18: Summary of 2008 Traffic Queuing With 3-Lane SR 28

	Direction of Travel		
	Eastbound	Westbound	Both
# Days per Summer On Which Queuing Would Occur	56	72	54
# Hours per Summer of Queuing	191	302	172
Average Daily Hours of Queuing			
- On Fridays in August	4.4	5.0	--
- On Saturdays in August	5.2	7.2	--
- On Sundays in August	2.0	7.0	--
- On Other Weekdays in August	2.2	3.6	--
Maximum # of Hours of Queuing per Day	8	10	--

Number of Days Per Summer On Which Queuing Would Occur By # of Hours Per Day

# Hours of Queuing per Day	Eastbound	Westbound	
0	53	37	--
1	8	10	--
2	13	11	--
3	13	11	--
4	7	12	--
5	7	5	--
6	3	7	--
7	4	6	--
8	1	8	--
9	0	1	--
10	0	1	--
11	0	0	--
12	0	0	--

Number of Summer Hours of Diverted Traffic Volume

Vehicles per Hour)		Hours per Summer		
From	To	Eastbound	Westbound	
1	100	122	187	--
101	200	55	82	--
201	300	10	22	--
301	400	4	9	--
401	500	0	2	--
Total		191	302	--

TABLE 19: 2008 Calender of Summer Hours of Traffic Queues

With 3-Lane SR 28

Week Beginning	Day of the Week						
	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Eastbound Daily Hours of Traffic Queue							
09-Jun							
16-Jun					1	2	
23-Jun		1				2	
30-Jun			3	6	5	8	7
07-Jul			3		2	4	4
14-Jul	1		2	1		3	6
21-Jul		1	2	2	2	5	7
28-Jul	4		3	2	3	4	7
04-Aug	5	4	3	3	5	5	7
11-Aug	4	3	3	3	3	4	6
18-Aug		2	2	2	2	3	1
25-Aug						1	5
01-Sep	5					1	
08-Sep						3	
15-Sep							
Westbound Daily Hours of Traffic Queue							
09-Jun							
16-Jun					1	3	5
23-Jun	2			1		2	1
30-Jun	3	3	3	6	5	10	9
07-Jul	5	1	2	2	3	4	6
14-Jul	5	1	2	1	2	6	7
21-Jul	7	2	3	2	4	4	8
28-Jul	8	3	3	4	4	4	8
04-Aug	7	7	4	6	7	7	8
11-Aug	8	3	6	5	6	6	8
18-Aug	8	2	3	3	4	4	4
25-Aug	4		1			1	4
01-Sep	8	2				1	
08-Sep						1	
15-Sep						2	

Roadway Volumes Exceeding TRPA LOS E Standard

The analysis presented above evaluates roadway capacity at the LOS E/F level, where volume is equal to 100 percent of capacity. The TRPA standard of LOS E is equivalent to a volume / capacity ratio of 90 percent. Re-running the analysis for this lower LOS level indicates that eastbound traffic volumes would exceed the TRPA standard for 384 hours per summer in the eastbound direction, and 538 hours per summer in the westbound direction.

EVALUATION OF 2028 TRANSPORTATION CONDITIONS

This analysis is conducted for 2028 conditions, defined as 20 years after construction of the proposed project. While optimally a valid and calibrated regional traffic computer model wouldbe available as the source for long-term traffic forecasts, one does not currently exist for the Tahoe Region. It is therefore necessary to conduct a detailed analysis of the potential "buildout" of the various land use plans, as well as other factors, that will result in additional traffic on Kings Beach streets. Table 20 presents a summary of the intersection turning movements generated by each source of traffic volume growth. These volumes were generated as follows:

- The TRPA has designated a series of Community Plan areas around the Tahoe Region. The land uses and associated traffic generation of the various North Shore Community Plan areas is shown in Table 21. As presented in the North Tahoe Community Plans EIR/EIS and the Tahoe City Community Plan EIR/EIS, this traffic was distributed to the various North Tahoe major roadways, which provided future buildout turning movements at the SR 28/SR 267 intersection. For instance, the top portion of Table 20 presents these turning movements for the buildout of the Community Plans between Tahoe Vista and Tahoe City. For the intersections east of SR 267, turning volumes on the side streets were estimated based upon the existing turning movement patterns in Kings Beach.

- The impacts of the Kings Beach Industrial Community Plan (which encompasses the area along Speckled Avenue) was distributed in a similar fashion. It was assumed that all of this traffic exits Speckled Avenue onto SR 267.

- The impacts of the Kings Beach Commercial Community Plan was identified based upon the trip generation shown in Table 21 and the distribution pattern presented in the North Tahoe Community Plans EIR/EIS. It was also necessary to allocate the traffic generation to the areas served by the various side streets along SR 28, which was done based upon the existing traffic patterns. The resulting individual intersection turning movements onto and off of SR 28 were then balanced to yield the total impacts on intersection turning movements.

- Traffic impacts associated with Community Plan buildout in Incline Village / Crystal Bay were estimated in a similar fashion to that used to estimate the impacts of the Community Plans to the west of Kings Beach

- Residential development in the Tahoe Basin outside of the community plan areas was based upon the number of remaining dwelling unit allocations in each area and the distribution of traffic generated in each community presented in the community plan environmental

TABLE 20: 2002-2028 Growth in Traffic Volumes

SR 28 @	Southbound Left	Southbound Thru	Southbound Right	Westbound Left	Westbound Thru	Westbound Right	Northbound Left	Northbound Thru	Northbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	TOTAL
Impact of Tahoe Vista – Tahoe City Residential Development													
267	0	0	12	0	35	0	0	0	0	11	34	0	92
Secline	0	0	0	0	35	0	0	0	0	0	34	0	69
Deer	0	0	1	0	34	0	0	0	0	1	33	0	69
Bear	0	0	1	0	33	0	0	0	0	1	32	0	67
Coon	0	0	2	0	31	0	0	0	0	0	31	1	65
Fox	0	0	1	0	30	0	0	0	0	1	30	0	62
Chipmunk	0	0	1	0	29	0	0	0	0	2	28	0	60
Impact of Kings Beach Industrial Community Plan													
267	5	0	4	0	0	5	0	0	0	4	0	0	18
Secline	0	0	0	0	5	0	0	0	0	0	5	0	10
Deer	0	0	0	0	5	0	0	0	0	0	5	0	10
Bear	0	0	0	0	5	0	0	0	0	0	5	0	10
Coon	0	0	1	0	4	0	0	0	0	0	4	1	10
Fox	0	0	1	0	3	0	0	0	0	1	3	0	8
Chipmunk	0	0	0	0	3	0	0	0	0	0	3	0	6
Impact of Kings Beach Commercial Community Plan													
267	14	0	11	0	5	18	0	0	0	1	34	0	83
Secline	6	0	5	0	34	6	0	0	0	5	34	0	90
Deer	4	0	3	0	37	4	0	0	0	3	37	0	88
Bear	8	0	9	0	32	8	9	0	0	9	32	0	107
Coon	12	0	14	0	27	12	0	0	0	14	27	0	106
Fox	7	0	10	0	30	7	0	0	0	10	30	0	94
Chipmunk	3	0	4	0	33	3	0	0	0	4	33	0	80
Impact of Stateline to Incline Village Community Plans													
267	26	0	0	0	56	28	0	0	0	0	54	0	164
Secline	1	0	0	0	84	1	0	0	0	0	80	0	166
Deer	1	0	0	1	85	0	0	0	0	0	81	0	167
Bear	0	0	0	1	86	1	0	0	2	0	82	0	171
Coon	2	0	0	1	87	1	0	0	0	0	82	0	174
Fox	2	0	0	0	90	2	0	0	0	0	84	0	177
Chipmunk	1	0	0	0	91	1	0	0	0	0	86	0	178
Impact of Tahoe Vista – Tahoe City Residential Development													
267	0	0	5	0	17	0	0	0	0	3	9	0	34
Secline	0	0	0	0	17	0	0	0	0	0	9	0	26
Deer	0	0	1	0	16	0	0	0	0	0	9	0	26
Bear	0	0	1	0	15	0	0	0	0	0	9	0	25
Coon	0	0	0	0	15	0	0	0	0	0	8	1	24
Fox	0	0	1	0	14	0	0	0	0	0	8	0	23
Chipmunk	0	0	0	0	14	0	0	0	0	0	8	0	22
Impact of Kings Beach Residential Development													
267	14	0	11	0	21	18	0	0	0	17	39	0	120
Secline	2	0	3	0	36	3	0	0	0	4	49	0	97
Deer	1	0	4	0	35	2	0	0	0	3	48	0	93
Bear	3	0	7	0	30	4	0	0	0	9	40	0	93
Coon	5	0	11	0	23	7	0	0	0	14	29	0	89
Fox	3	0	7	0	23	3	0	0	0	10	24	0	70
Chipmunk	0	0	4	0	22	1	0	0	0	4	23	0	54
Impact of Incline Village Residential Development													
267	37	0	0	0	40	20	0	0	0	0	74	0	171
Secline	1	0	0	0	60	1	0	0	0	0	111	0	173
Deer	1	0	0	0	61	0	0	0	0	0	112	0	174
Bear	0	0	0	0	61	1	0	0	2	0	113	0	178
Coon	2	0	0	0	63	2	0	0	1	0	113	0	181
Fox	2	0	0	0	64	1	0	0	0	0	115	0	183
Chipmunk	1	0	0	0	65	0	0	0	0	0	117	0	184
Impact of Town of Truckee Development													
267	150	0	122	0	0	262	0	0	0	124	0	0	658
Secline	0	0	0	0	262	0	0	0	0	0	122	0	384
Deer	0	0	8	0	254	0	0	0	0	3	118	1	384
Bear	0	0	7	0	245	0	2	0	0	2	114	2	372
Coon	0	0	8	0	235	0	2	0	0	2	109	3	359
Fox	0	0	7	0	228	0	0	0	0	3	106	0	344
Chipmunk	0	0	9	0	219	0	0	0	0	4	102	0	334
Impact of Martis Valley Community Plan													
267	95	0	77	0	0	152	0	0	0	72	0	0	396
Secline	0	0	0	0	152	0	0	0	0	0	72	0	224
Deer	0	0	5	0	147	0	0	0	0	1	70	1	224
Bear	0	0	4	0	142	0	1	0	0	2	67	1	217
Coon	0	0	5	0	136	0	1	0	0	1	65	1	209
Fox	0	0	4	0	132	0	0	0	0	2	63	0	201
Chipmunk	0	0	5	0	127	0	0	0	0	3	60	0	195
Impact of Increase in Through Traffic Through All of North Tahoe / Truckee / Incline Village Region													
267	21	0	0	0	0	20	0	0	0	0	0	0	40
Secline	0	0	0	0	20	0	0	0	0	0	21	0	40
Deer	0	0	0	0	20	0	0	0	0	0	21	0	40
Bear	0	0	0	0	20	0	0	0	0	0	21	0	40
Coon	0	0	0	0	20	0	0	0	0	0	21	0	40
Fox	0	0	0	0	20	0	0	0	0	0	21	0	40
Chipmunk	0	0	0	0	20	0	0	0	0	0	21	0	40

TABLE 21: Traffic Generation of Future Land Uses in North Tahoe Region

Area/Land Use	Size	Units	Trip Generation Rate: Peak Hour In	Trip Generation Rate: Peak Hour Out	Trip Generation Rate: ADT	Total Trips: Peak Hour In	Total Trips: Peak Hour Out	Total Trips: Peak Hour Total	Total Trips: ADT	Trip Reductions: Intercept	Trip Reductions: Pass-by	Newly-Generated Trips: Peak Hour In	Newly-Generated Trips: Peak Hour Out	Newly-Generated Trips: Peak Hour Total	Newly-Generated Trips: ADT
Carnelian Bay Community Plan															
Commercial: New Allocation	2	KSF	2.5	2.5	40.7	5	5	10	80	40%	30%	2	2	4	24
Beach Recreation	40	PAOT	0.06	0.06	0.57	2	2	4	20	60%	20%	0	0	0	4
TOTAL						7	7	14	100			2	2	4	28
Tahoe Vista Community Plan															
Commercial: New Allocation	7.5	KSF	2.5	2.5	40.7	19	19	38	310	40%	30%	6	6	12	93
Housing Units	10	units	0.64	0.37	10.06	6	4	10	100	60%	20%	1	1	2	20
TOTAL						25	23	48	410			7	7	14	113
Kings Beach Commercial Community Plan															
Commercial (1)	80	KSF	2.5	2.5	40.7	200	200	400	3,260	40%	30%	60	60	120	978
Beach Recreation	750	PAOT	0.06	0.06	0.57	45	45	90	430	40%	10%	23	23	46	215
Public Pier		–	–	–	–	10	10	20	140	60%	20%	2	2	4	28
TOTAL						255	255	510	3,830			85	85	170	1,221
Kings Beach Industrial Community Plan															
Commercial: New Allocation	13	KSF	2.5	2.5	40.7	33	33	66	530	40%	30%	10	10	20	159
Police Substation	–		–	–	–	0	5	10	50	100%	0%	0	0	0	0
TOTAL						33	38	76	580			10	10	20	159
North Stateline Community Plan															
Commercial	19.6	KSF	2.5	2.5	40.7	49	49	98	800	40%	30%	15	15	30	240
Tourist Units: Transfer	45	units	0.40	0.32	8.00	18	14	32	360	10%	0%	16	13	29	324
Housing Units	50	MFDU	0.38	0.28	6.10	19	14	33	310	20%	0%	15	11	26	248
TOTAL						86	77	163	1,470			46	39	85	812
Incline Commercial Community Plan															
Commercial: New	23	KSF	2.5	2.5	40.7	58	58	116	950	40%	30%	17	17	34	285
Housing Units	92	MFDU	0.38	0.28	6.10	35	26	61	560	20%	0%	28	21	49	448
TOTAL						93	84	177	1,510			45	38	83	733
Incline Tourist Community Plan															
Commercial: New	12	KSF	2.5	2.5	40.7	30	30	60	480	40%	30%	9	9	18	144
Housing Units	110	DU	0.64	0.37	10.06	70	41	111	1,110	20%	0%	56	33	89	888
College Expansion	500	Students	0.07	0.16	2.37	33	82	115	1,190	0%	0%	33	82	115	1,190
TOTAL						133	153	286	2,780			98	124	222	2,222
Ponderosa Ranch Community Plan															
Commercial: New	17	KSF	2.5	2.5	40.7	41	41	82	670	40%	30%	12	12	24	201
Housing Units	50	MFDU	0.38	0.28	6.10	19	14	33	310	20%	0%	15	11	26	248
TOTAL						60	55	115	980			27	23	50	449
Tahoe City Community Plan															
Commercial (1)	90	KSF	2.50	2.50	41	225	225	450	3,660	40%	30%	68	68	136	1,098
Tourist Units	25	Units	0.50	0.40	10.0	13	10	23	250	10%	0%	12	9	21	225
Housing Units	20	Units	0.64	0.37	10	13	7	20	200	20%	0%	10	6	16	160
Marina	400	slips	0.10	0.10	3	40	40	80	1,200	0%	30%	28	28	56	840
Summer Visitors	600	PAOT	0.05	0.05	2	30	30	60	1,200	40%	10%	15	15	30	600
Transit Terminal						78	117	195	1,300	0%	92%	6	9	15	104
TOTAL						399	429	828	7,810			139	135	274	3,027
West Shore Community Plan															
Commercial (1)	30	KSF	2.50	2.50	41	75	75	150	1,220	40%	30%	23	23	46	366
Tourist Units	95	Units	0.50	0.40	10.0	48	38	86	950	10%	0%	43	34	77	855
Campground Users	900	POA	0.09	0.07	2	80	64	144	1,440	10%	0%	72	58	130	1,296
Summer Day Visitors	600	PAOT	0.05	0.05	2	30	30	60	1,200	40%	10%	15	15	30	600
TOTAL						233	207	440	4,810			153	130	283	3,117
Additional Housing Units															
West Shore	258	DU	0.64	0.37	10.06	165	95	260	2,600	20%	0%	132	76	208	2,080
Tahoe City Area	215	DU	0.64	0.37	10.06	138	80	218	2,160	20%	0%	110	64	174	1,728
Tahoe Vista Area	172	DU	0.64	0.37	10.06	110	64	174	1,730	20%	0%	88	51	139	1,384
Kings Beach Area	215	DU	0.64	0.37	10.06	138	80	218	2,160	20%	0%	110	64	174	1,728
Incline Village	900	DU	0.64	0.37	10.06	576	333	909	9,050	20%	0%	461	266	727	7,240

Note 1: Assuming that half of the 80,000 in bonus commercial floor area develops in the Tahoe City area, and half in the Kings Beach area.

SOURCE: "North Tahoe Community Plan EIR/EIS", TRPA, 1996, and "Revised Draft Environmental Impact Report/Statement: Tahoe City Community Plan" (1993), Sue Rae Irelan Environmental Planning.

documents. The number of additional dwelling units that could be constructed in each area is based upon information provided by Placer County Planning Department and TRPA.

- Traffic impacts associated with Town of Truckee development were identified from the Town's TMODEL traffic model, which provided traffic volume impacts on SR 267 at Brockway Summit, as shown in Table 22. These volumes were reduced by 5 percent to reflect traffic to/from areas along SR 267 between Brockway Summit and SR 28, and allocated to turning movements at SR 267/SR 28 based on existing turning movement patterns. Turning movements at the local side streets along SR 28 were estimated based upon current turning movement patterns.

- Traffic impacts associated with the Martis Valley Community Plan were estimated in a fashion identical to that presented above regarding the Town of Truckee General Plan impacts. These volumes reflect the revised version of the Preferred Alternative (a total of 8,600 dwelling units), factored to reflect the highest growth rate considered by the Placer County Planning Department to be feasible. Specifically, the Placer County Planning Director has developed a range of feasible growth scenarios for the Martis Valley land uses, which range up to a growth rate of 6 percent. At this highest growth rate, 6,665 dwelling units would be built-out in 2028 (equal to 95.6 percent of the plan total). The traffic volumes identified in the *Draft Martis Valley Community Plan EIR* (PMC, 2003) were reduced by 11 vehicles per hour in the southbound direction and 8 vehicles per hour in the northbound direction to reflect this level of buildout in 2028.

- Finally, it is necessary to estimate the future growth in vehicles traveling completely through the other areas considered (North Tahoe, Martis Valley, and the Town of Truckee). To be considered a "through" trip, for example, a vehicle would need to travel from Donner Summit or beyond to beyond Incline Village. While there is no data available regarding trip patterns, the proportion of traffic on SR 28 in Kings Beach that does not make any stops within this large study area would be no more than 5 percent. Using the counts conducted in the Summer of 2002, the 30th-highest peak-hour counts were 1,160 eastbound and 1,100 westbound. Applying the five percent factor, through traffic in 2000 was no more than 112 eastbound and 103 westbound. Caltrans counts from 1991 through 2001 indicate the highest growth in peak-month daily volumes on nearby roadways was 1.18 percent on SR 267 over Brockway Summit. Factoring the existing through estimates by this growth rates indicates that peak-hour peak-month through volumes will grow by 21 eastbound and 20 westbound by 2028.

Note that no growth in traffic volumes in Kings Beach was included to reflect additional development on the West Shore or in Alpine Meadows/Squaw Valley. In Tahoe City, there are no plans adopted or under consideration that would increase the roadway capacity of SR 28, nor are any such improvements (such as an additional east-west roadway) reasonably feasible. This indicates that there is little potential that growth in traffic generation west of Tahoe City would actually increase volumes in Kings Beach significantly.

The traffic volumes associated with the various growth elements shown in Table 20 were added to the 2002 design volumes shown in Table 8. In addition, the traffic volume impacts were adjusted

TABLE 22: Impact of Truckee and Martis Valley Growth on Traffic Volumes in Kings Beach

Assumptions: *Build Out of Town of Truckee General Plan*
Highest Potential Growth Rate (6 %) of the Martis Valley Community Plan Revised Proposed Land Use Diagram (8,600 Dwelling Units)

Area	Total Growth in PM Peak-Hour Volumes at Brockway Summit (1)			% of Traffic To/From Land Uses Along SR 267		Volume Just N of SR 28		% of Traffic on SR 267 at Intersection with SR 28 Traveling to/from SR 28 to East (2)		SR 267 / SR 28 Pk-Hr Turning Movement			
										Southbound		Westbound	Eastbound
	NB	SB	Total	NB	SB	NB	SB	NB	SB	Left	Right	Right	Left
Town of Truckee - SR 267	406	286	692	5%	5%	386	272	68%	55%	150	122	262	124
Martis Valley - SR 267	236	181	417	5%	5%	224	172	68%	55%	95	77	152	72

Note 1: Based on Town of Truckee TMODEL for General Plan Buildout, and draft Martis Valley Community Plan traffic analysis for preferred land use alternative.
Note 2: Based upon existing traffic count data.

to reflect the conversion of Brook Avenue between Bear Street and Coon Street. The resulting traffic volumes, unconstrained by limits on roadway capacity (other than the Tahoe City constraint discussed above), are presented in Table 23.

For purposes of this traffic analysis, however, it is assumed that the existing traffic metering effect associated with the North Stateline pedestrian-actuated signal continues to limit peak traffic flows along SR 28 in 2028. This signal is located between the Tahoe Biltmore Casino and the Crystal Bay Club, and is actuated by pedestrian push buttons on either side of the roadway. Observations conducted by LSC staff indicates that, during periods of peak pedestrian activity, this signal operates on a 95 second cycle length, with 65 seconds of green time for SR 28 traffic, 26.5 seconds of red time, and 3.5 seconds of yellow time. Analyzing this timing plan using the *Highway Capacity Software* (with a saturated flow rate of 1,600 vehicles per hour), the roadway capacity provided by this signal was calculated to equal 1,160 vehicles per hour in each direction at the signal location.

The unconstrained traffic volumes shown in Table 23 indicate that the 2028 design volumes on SR 28 east of Chipmunk Street are equal to 1,468 and 1,554 vehicles per hour in the eastbound and westbound directions, respectively. However, available turning movement counts indicate that traffic volumes tend to drop slightly between this location and the North Stateline signal. Counts conducted for the *Cal Neva Resort Timeshare Development Traffic and Air Quality Study* (LSC, 2001), as well as counts conducted at SR 28 / Beaver Street and SR 28 / Speedboat Avenue by LSC staff in July, 2003 indicates that traffic volumes drop between Chipmunk Street and the North Stateline signal by approximately 40 vehicles per hour. Adjusting for these figures, the design volumes at the North Stateline signal in 2028 are 1,428 and 1,514 vehicles per hour, in the eastbound and westbound directions respectively. Comparing these figures with the capacity of 1,160 vehicles per hour, the North Stateline signal effectively would reduce traffic volumes on SR 28 in Kings Beach by 268 vehicles per hour eastbound and 354 vehicles per hour westbound.

These figures represent vehicles either queuing to pass through the North Stateline signal, or drivers who choose to travel at another time to avoid the roadway congestion. Experience at other Tahoe locations with recurring queuing (such as SR 89 at Fanny Bridge) indicates that traffic volumes at locations both before and after the constraint are reduced, as drivers learn to plan their trip times to avoid traffic delays. Comparing the unconstrained traffic forecasts with these constraint volumes, the scope of the eastbound traffic queues formed by the North Stateline would impact Kings Beach in 2028 can be calculated, assuming that the capacity of SR 28 in Kings Beach would be sufficient to deliver the volume to North Stateline. Traffic queues would form back into the eastern part of Kings Beach on a total of 43 days. On 28 of these days, queues would form back as far west as SR 267. The maximum total length of eastbound queue (excluding the 4th of July period) would be roughly 8 miles.

Adjusting for this capacity constraint, Table 24 presents the 2028 summer peak-hour design volumes. In the westbound direction, these volumes represent the level of traffic that can be delivered to Kings Beach given the capacity constraint at North Stateline, while in the eastbound direction they represent the volume that would be able to pass through each intersection given the presence of eastbound queues formed by the North Stateline signal. Comparing these figures with

TABLE 23: Peak-Hour Summer 2028 Intersection Turning Movement Volumes – Not Constrained by North Stateline Signal

	Southbound				Westbound			Northbound			Eastbound			
SR 28 @	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	TOTAL
267	685	1	506		3	849	944	1	0	3	434	1,078	1	4,506
Secline	50	2	25		22	1,759	47	24	1	26	51	1,643	11	3,660
Deer	10	0	46		26	1,748	28	0	0	5	44	1,640	16	3,562
Bear	54	4	83		41	1,691	85	24	0	77	99	1,480	62	3,699
Coon	102	27	144		34	1,586	32	38	7	43	80	1,424	84	3,602
Fox	50	3	81		3	1,526	84	0	0	0	75	1,469	0	3,290
Chipmunk	26	0	36	*	0	1,532	21	0	0	0	54	1,442	0	3,111

TABLE 24: Peak-Hour Summer 2028 Intersection Turning Movement Design Volumes (Constrained)

SR 28 @	Southbound			Westbound			Northbound			Eastbound			TOTAL
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
267	581	1	506	3	682	758	1	0	3	434	915	1	3,884
Secline	50	2	25	22	1,406	47	24	1	26	51	1,375	11	3,039
Deer	10	0	46	26	1,394	28	0	0	5	44	1,372	16	2,941
Bear	54	4	83	41	1,337	85	24	0	77	99	1,213	62	3,078
Coon	102	27	144	34	1,233	32	38	7	43	80	1,157	84	2,981
Fox	50	3	81	3	1,172	84	0	0	0	75	1,202	0	2,669
Chipmunk	26	0	36	0	1,179	21	0	0	0	54	1,174	0	2,490

the 2002 design volumes shown in Table 8, 2028 volumes are estimated to exceed existing volumes by approximately 24 percent in the eastbound direction and 33 percent in the westbound direction.

Four-Lane / Signals Alternative

Intersection LOS

The results of LOS analysis for this alternative in 2028 is presented in Table 25. Without further improvements other than the planned eastbound and westbound left-turn phase, the SR 28 / SR 267 intersection would operate at LOS F. To attain adequate LOS at the SR 28 / SR 267 intersection, a separate westbound right-turn lane is required, which would provide LOS D conditions. Lengthening of existing turn lanes may also be necessary to accommodate traffic queues. The SR 28 / Bear Street signal would operate at LOS A, while the SR 28 / Coon Street signal would operate at LOS B. All unsignalized intersections operate with a worst-movement LOS of F.

Roadway LOS

To analyze roadway LOS under this roadway configuration, the Highway Capacity Manual methodology for urban arterials was applied. Under this methodology, LOS is a measure of total travel speed through the corridor. For the design period in the peak direction, LOS D was found for 2028 conditions in the peak direction, the a travel speed of 17.3 miles per hour.

Three-Lane + Roundabout Alternative

Intersection LOS

The results of this LOS analysis are presented in Table 26. As indicated, all unsignalized intersections will operate with a worst-approach LOS of F. As with the 2008 analysis, LOS and delay levels at these unsignalized intersections are substantially worse with the three-lane roadway configuration than with the four-lane configuration, due to the lower frequency of gaps in the SR 28 traffic stream.

As a whole, the roundabouts are forecast to operate at LOS B for the SR 28 / SR 267 and SR 28 / Bear Street locations, and LOS A for the SR 28 / Coon Street location. Worst-approach LOS are forecast to be LOS C at the SR 267 location and LOS B at the other two locations. The SR 28 / SR 267 has been evaluated with an outside diameter of 36 meters (118 feet). The roundabouts at Bear and Coon were evaluated with an outside diameter of 30 meters (98 feet).

Roadway Level of Service

The hourly traffic volumes identified in the 2002 Caltrans counts presented in Table 8 were increased to reflect the growth in link volumes identified for 2028 conditions in Table 24. In addition, the effect of the capacity constraint at the North Stateline signal was used as a capacity limitation on the maximum roadway directional volume on SR 28 east of SR 267. Specifically,

TABLE 25: 2028 Four-Lane Alternative Peak-Hour Intersection LOS

SR 28 @	Existing Traffic Control	No Project LOS: Worst Approach Delay (s/veh)	Worst Approach LOS	Total Intersection Delay (s/veh)	Total Intersection LOS
Existing Intersection Configuration (Unmitigated)					
SR 267	Signal	—	—	112.1	F
Secline Street	Two-Way Stop Controlled	(2)	F	—	—
Deer Street	Two-Way Stop Controlled	192.8	F	—	—
Bear Street	Signal	—	—	9.8	A
Coon Street	Signal	—	—	10.1	B
Fox Street	Two-Way Stop Controlled	967.8	F	—	—
Chipmunk Street	Two-Way Stop Controlled	187.8	F	—	—
Required Intersection Configuration (Mitigated)					
SR 267	Signal	—	—	43.1	D
Requires Separate Westbound Right-Turn Lane					

Note 1: Although the none of the minor street southbound approaches are striped with separate right-turn lanes, the southbound approaches to the Secline and Bear intersections are wide and used as if there are separate right-turn lanes. Therefore, the LOS at these two intersections was calculated assuming separate right-turn lanes on the southbound approaches.

Note 2: Delay level too high to calculate

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TABLE 26: 2028 Three-Lane Alternative Peak-Hour Intersection LOS

SR 28 @	Existing Traffic Control	No Project LOS			
		Worst Approach		Total Intersection	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
SR 267	Roundabout	32.0	C	10.0	B
Secline Street (1)	Two-Way Stop Controlled	(2)	F	—	—
Deer Street	Two-Way Stop Controlled	913.0	F	—	—
Bear Street	Roundabout	9.6	B	9.5	B
Coon Street	Roundabout	12.6	B	6.3	A
Fox Street	Two-Way Stop Controlled	(2)	F	—	—
Chipmunk Street	Two-Way Stop Controlled	640.9	F	—	—

Note 1: Although the none of the minor street southbound approaches are striped with separate right-turn lanes, the southbound approaches to the Secline and Bear intersections are wide and used as if there are separate right-turn lanes. Therefore, the LOS at these two intersections was calculated assuming separate right-turn lanes on the southbound approaches.

Note 2: Delay level too high to calculate

KB Summer 08 LOS.wb3

the design roadway volumes on SR 28 east of SR 267 were calculated to exceed the volumes east of Chipmunk Street by 298 vehicles per hour in the eastbound direction and 243 vehicles per hour in the westbound direction. These volumes were added to the capacity constraint volumes east of Chipmunk Street to identify the comparable capacity constraint east of SR 267 of 1,498 and 1,443 vehicles per hour in the eastbound and westbound direction, respectively. These volumes were then used to cap the hourly directional traffic volumes over the course of the summer.

The resulting 2028 estimated directional hourly traffic volumes are presented in Appendix E. Comparing these volumes with the capacity of the three-lane roadway cross-section (as presented above in the discussion of 2008 conditions), hourly traffic volumes would exceed roadway capacity on a frequent basis throughout the summer, resulting in traffic queuing and diversion of SR 28 traffic onto other alternative roadways. Table 27 presents a summary of the hour-by-hour evaluation of capacity and traffic volume throughout the summer:

- Traffic volumes in the westbound direction would exceed roadway capacity (forming traffic queues) for at least one hour on every one of the 108 days from June 15 through the end of September, in both the eastbound and the westbound directions.

- Over the course of the summer, traffic queues would occur for 903 hours in the eastbound direction and 1,178 hours in the westbound direction. In 898 of these hours, queues would be present in both directions at the same time.

- In August, the average number of hours of queuing in the westbound direction would range from 11.8 hours on Sundays up to 13.0 hours of Fridays, while in the eastbound direction the daily hours of queuing would range from 8.9 hours Monday through Thursday up to 11.2 hours on Saturdays.

- The maximum number of hours per day in which volume would exceed roadway capacity would be 13 hours in the eastbound direction and 14 hours in the westbound direction.

- As discussed above in the 2008 analysis, it can be expected that the typical driver's reaction to the traffic queuing will be to divert off of SR 28 onto local Kings Beach roadways. In particular, drivers traveling between SR 28 to the east of Kings Beach and SR 267 to the north of Kings Beach would find diverting onto the local streets would save travel time. As shown in the bottom portion of Table 27, it can be expected that this level of diversion would frequently reach over 300 vehicles per hour in the eastbound direction and over 400 vehicles per hour in the westbound direction. The peak diverted volumes would be between 400 and 500 vehicles per hour eastbound, and between 500 and 600 vehicles per hour westbound, reflecting the capacity constraint imposed by the North Stateline pedestrian signal. (As a check, the total 2028 volume for southbound left-turn movements onto SR 28 from SR 267 through Coon Street is forecast to equal 795, while the equivalent westbound right-turn movement volume is forecast to equal 950. This indicates that there is adequate traffic movement between SR 28 east of the key roadway segments and points to the northwest to equal or exceed the shortfall in roadway capacity.)

TABLE 27: Summary of 2028 Traffic Queuing With 3-Lane SR 28

	Direction of Travel		
	Eastbound	Westbound	Both
# Days per Summer On Which Queuing Would Occur	108	108	108
# Hours per Summer of Queuing	903	1,178	898
Average Daily Hours of Queuing			
- On Fridays in August	11.2	13.0	--
- On Saturdays in August	10.6	12.0	--
- On Sundays in August	10.0	11.8	--
- On Other Weekdays in August	8.9	12.4	--
Maximum # of Hours of Queuing per Day	13	14	--

Number of Days Per Summer On Which Queuing Would Occur By # of Hours Per Day

# Hours of Queuing per Day	Eastbound	Westbound	
0	0	0	--
1	0	0	--
2	1	0	--
3	1	0	--
4	5	0	--
5	6	0	--
6	10	0	--
7	12	1	--
8	18	6	--
9	25	6	--
10	17	21	--
11	6	25	--
12	6	25	--
13	2	15	--
14	0	10	--
15	0	0	--

Number of Summer Hours of Diverted Traffic Volume

Diverted Traffic Volume (1-Way Vehicles per Hour)		Hours per Summer		
From	To	Eastbound	Westbound	
1	100	145	163	--
101	200	132	146	--
201	300	157	144	--
301	400	148	185	--
401	500	321	168	--
501	600	0	372	--
601	700	0	0	--
701	800	0	0	--
801	900	0	0	--
Total		903	1,178	--

Table 28 presents the Summer 2028 "calendar" of daily hours of roadway congestion (and associated cut-through traffic). As indicated, eight hours per day or more of roadway congestion would be common in both directions throughout July and August.

Roadway Volumes Exceeding TRPA LOS E Standard

The analysis presented above evaluates roadway capacity at the LOS E/F level, where volume is equal to 100 percent of capacity. The TRPA standard of LOS E is equivalent to a volume / capacity ratio of 90 percent. Re-running the analysis for this lower LOS level indicates that eastbound traffic volumes would exceed the TRPA standard for 1,063 hours per summer in the eastbound direction, and 1,303 hours per summer in the westbound direction. The TRPA standard would be exceeded for up to 14 hours per day in the eastbound direction, and 15 hours per day in the westbound direction.

Impact of Eliminating North Stateline Constriction

An alternative potential condition in 2028 is that the existing North Stateline pedestrian signal is eliminated as a constriction on traffic flow along SR 28 (such as through provision of a grade separation, or changes in land uses). This would effectively eliminate the "cap" on traffic volumes along SR 28 in Kings Beach, allowing volumes to reach levels that exceed the capacity-constrained volumes by 268 and 354 vehicles per hour in the eastbound and westbound direction, respectively. These volumes are shown in Table 23, above. As a result, the level by which traffic volumes would exceed the roadway capacity in Kings Beach would increase at the busiest of times. As shown in Table 29, the number of days of traffic queuing (and diversion onto local streets) would remain the same as with the capacity constraint. However, the maximum traffic volume not accommodated by the roadway capacity would increase from less than 500 to more than 900 in the eastbound direction, and from less than 600 to more than 1,200 in the westbound direction. Intersections would operate at acceptable LOS under the configurations identified for the constrained traffic volumes, with the exception of the SR 267 / SR 28 intersection, which would require a separate southbound right-turn lane and westbound right-turn lane to achieve LOS E conditions in the peak hour, under the 4-lane alternative.

Sensitivity Analysis – Impact of 2028 Volumes 10 Percent Lower and 10 Percent Higher Than Base Case Forecasts

With any long-range traffic forecast, there is a high degree of uncertainty, particularly in regards to the actual level of development that will occur. In order to "test" the conclusions regarding 2028 traffic conditions, the analysis of roadway traffic queuing was conducted for growth in traffic levels both 10 percent below the base case forecasts discussed above, as well as 10 percent above the base case forecasts.

<u>Growth 10 Percent Lower Than Base Case Forecasts</u>

The summary of queuing conditions with traffic volumes 10 percent below the base case forecasts is presented as Table 30. Comparing these figures with those of the case conditions shown in Table 27, if 2028 traffic volumes are 10 percent lower than forecast the number of hours per

TABLE 28: 2028 Calender of Summer Hours of Traffic Queues
With 3-Lane SR 28

Week Beginning	Day of the Week						
	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Eastbound Daily Hours of Traffic Queue							
09-Jun	3	4	4	5	4	8	8
16-Jun	6	7	6	7	7	8	9
23-Jun	7	6	7	7	8	8	9
30-Jun	8	9	9	13	10	12	11
07-Jul	8	7	8	9	10	9	9
14-Jul	8	7	9	8	9	11	9
21-Jul	9	8	9	10	9	12	12
28-Jul	10	9	9	9	10	11	11
04-Aug	10	9	9	10	10	12	12
11-Aug	10	10	10	11	11	11	10
18-Aug	9	9	8	8	9	9	9
25-Aug	9	6	6	6	8	8	10
01-Sep	10	7	7	5	5	8	8
08-Sep	6	4	4	4	6	8	9
15-Sep	3	5	3	3	5	8	9
Westbound Daily Hours of Traffic Queue							
09-Jun	8	9	10	9	11	12	10
16-Jun	10	9	12	10	11	10	10
23-Jun	10	11	12	10	12	12	11
30-Jun	11	12	13	14	11	14	13
07-Jul	12	12	12	13	12	12	10
14-Jul	11	12	10	11	11	14	12
21-Jul	11	11	12	11	13	14	14
28-Jul	12	10	12	13	13	13	13
04-Aug	11	13	12	13	14	14	13
11-Aug	12	13	14	14	13	14	11
18-Aug	12	12	13	12	11	12	11
25-Aug	11	12	10	10	11	13	11
01-Sep	11	11	12	9	8	11	10
08-Sep	10	10	8	7	10	12	10
15-Sep	10	9	8	8	9	11	11

TABLE 29: Summary of 2028 Traffic Queuing With 3-Lane SR 28 and No Traffic Constriction At North Stateline

	Direction of Travel		
	Eastbound	Westbound	Both
# Days per Summer On Which Queuing Would Occur	108	108	108
# Hours per Summer of Queuing	861	1,154	898
Average Daily Hours of Queuing			
- On Fridays in August	11.2	13.0	--
- On Saturdays in August	10.6	12.0	--
- On Sundays in August	10.0	11.8	--
- On Other Weekdays in August	8.9	12.4	--
Maximum # of Hours of Queuing per Day	13	14	--

Number of Days Per Summer On Which Queuing Would Occur By # of Hours Per Day

# Hours of Queuing per Day	Eastbound	Westbound	
0	0	0	--
1	0	0	--
2	1	0	--
3	1	0	--
4	5	0	--
5	6	0	--
6	10	0	--
7	12	1	--
8	18	6	--
9	25	6	--
10	17	21	--
11	6	25	--
12	6	25	--
13	2	15	--
14	0	10	--
15	0	0	--

Number of Summer Hours of Diverted Traffic Volume

Diverted Traffic Volume (1-Way Vehicles per Hour)		Hours per Summer		
From	To	Eastbound	Westbound	
1	100	145	163	--
101	200	132	146	--
201	300	157	144	--
301	400	148	185	--
401	500	120	168	--
501	600	102	160	--
601	700	57	93	--
701	800	27	63	--
801	900	9	32	--
901	1000	7	10	--
1001	1100	0	8	--
1101	1200	0	3	--
1201	1300	0	1	--
Total		897	1,154	--

TABLE 30: Summary of 2028 Traffic Queuing With 3-Lane SR 28 and Traffic Growth 10% Lower Than Base Forecast

	Direction of Travel		
	Eastbound	Westbound	Both
# Days per Summer On Which Queuing Would Occur	108	108	108
# Hours per Summer of Queuing	847	1,118	842
Average Daily Hours of Queuing			
- On Fridays in August	10.6	12.6	–
- On Saturdays in August	10.6	11.8	–
- On Sundays in August	9.0	11.5	–
- On Other Weekdays in August	8.5	11.9	–
Maximum # of Hours of Queuing per Day	13	14	–

Number of Days Per Summer On Which Queuing Would Occur By # of Hours Per Day

# Hours of Queuing per Day	Eastbound	Westbound	
0	0	0	–
1	1	0	–
2	1	0	–
3	6	0	–
4	9	0	–
5	7	0	–
6	7	1	–
7	13	5	–
8	19	11	–
9	24	12	–
10	13	20	–
11	4	28	–
12	4	16	–
13	1	12	–
14	0	4	–
15	0	0	–

Number of Summer Hours of Diverted Traffic Volume

Diverted Traffic Volume (1-Way Vehicles per Hour)		Hours per Summer		
From	To	Eastbound	Westbound	
1	100	143	156	–
101	200	142	158	–
201	300	173	170	–
301	400	134	192	–
401	500	255	157	–
501	600	0	285	–
601	700	0	0	–
701	800	0	0	–
801	900	0	0	–
Total		847	1,118	–

summer of traffic queues would be reduced but would still occur on a frequent basis. Specifically, the hours of eastbound queuing would be 847 rather than 903, while the hours of westbound queuing would be 1,118 rather than 1,178. The average daily hours of queuing on an August day would drop by roughly one-hour, in both directions, and the number of days on which queuing occurs would not be materially changed. Capped by the capacity of SR 28 at the North Stateline signal, peak traffic volumes diverting onto residential streets would remain the same, though the hours per summer of these peak diverted traffic volumes would drop.

Growth 10 Percent Higher Than Base Case Forecasts

A similar summary table of 2028 queuing conditions assuming traffic volumes 10 percent higher than the base case conditions is presented as Table 31. Again comparing with the Table 27 base case figures, the hours of eastbound queuing per summer would increase from 903 to 959, while the hours of westbound queuing would increase from 1,178 to 1,237. Again, neither the number of days on which queuing would occur or the peak traffic volumes diverting onto residential streets would be materially affected. However, the hours of peak traffic diversion would increase.

TABLE 31: Summary of 2028 Traffic Queuing With 3-Lane SR 28 and Traffic Growth 10% Higher Than Base Forecast

	Direction of Travel		
	Eastbound	Westbound	Both
# Days per Summer On Which Queuing Would Occur	108	108	108
# Hours per Summer of Queuing	959	1,237	955
Average Daily Hours of Queuing			
- On Fridays in August	11.2	13.2	--
- On Saturdays in August	10.8	13.0	--
- On Sundays in August	10.0	11.8	--
- On Other Weekdays in August	9.3	13.0	--
Maximum # of Hours of Queuing per Day	13	15	--

Number of Days Per Summer On Which Queuing Would Occur By # of Hours Per Day

# Hours of Queuing per Day	Eastbound	Westbound	
0	0	0	--
1	0	0	--
2	1	0	--
3	0	0	--
4	1	0	--
5	7	0	--
6	9	0	--
7	12	0	--
8	16	2	--
9	25	3	--
10	21	15	--
11	9	16	--
12	6	32	--
13	2	26	--
14	0	14	--
15	0	1	--

Number of Summer Hours of Diverted Traffic Volume

Diverted Traffic Volume (1-Way Vehicles per Hour)		Hours per Summer		
From	To	Eastbound	Westbound	
1	100	148	160	--
101	200	137	149	--
201	300	131	139	--
301	400	159	159	--
401	500	384	182	--
501	600	0	448	--
601	700	0	0	--
701	800	0	0	--
801	900	0	0	--
Total		959	1,237	--

Chapter 4
Evaluation of Significance and Potential Mitigation Measures

This chapter first presents the "standards of significance" against which traffic conditions are measured. The future conditions (2008: 4 Lanes/Signals, 2008: 3 Lanes/Roundabouts, 2023: 4 Lanes/Signals and 2023: 3 Lanes/Roundabouts) identified in Tasks 3 and 4 are then compared against the standards to identify the significance of specific impacts. As necessary, potential mitigation measures are evaluated.

STANDARDS OF SIGNIFICANCE

The following present the standards to be applied in this traffic study.

- The TRPA standard is to achieve LOS D or better at signalized intersections, with up to four hours at LOS E allowed. TRPA has no standards specific to unsignalized intersections, though intersection approaches with LOS F conditions are typically considered to be a concern by TRPA staff. (Bridget Cornell, TRPA, personal conversation). Traffic volumes exceeding a volume/capacity ratio of 90 % (the upper end of LOS E conditions) will be considered to exceed standards.

- Caltrans roadway standards are identified in a "Transportation Concept Report" prepared for each roadway. The "concept LOS" identified in the SR 28 Transportation Concept Report is LOS F. As the TRPA standards exceed this level, the TRPA standards are pertinent to this study.

- Placer County Department of Public Works has indicated that the maximum traffic volume along a largely residential local street (like the majority of Kings Beach's "internal" streets) to be 2,000 to 3,000 vehicles per day for streets serving residential zoning of ¼ acre or less with front-on lotting. While lots in Kings Beach were originally laid out to front on the east-west ("fish") streets, housing has developed that fronts onto every north-south street as well. For purposes of this study, a standard of 3,000 vehicles per day will be used as the upper limit for a residential street. An action that causes daily traffic levels to exceed this volume will be considered a significant impact.

- Existing adopted Kings Beach Community Plan goals and policies. In addition, the impact of these alternatives on non-auto travel modes (pedestrian, bicyclist and transit) will be evaluated. Any existing adopted goals, policies or plans that the roadway alternatives are found to be inconsistent with would be identified as a significant impact. It should be noted that the existing Kings Beach Community Plan identifies a 4-lane cross-section for the highway; as a result, the 3-lane alternative would be identified as having a significant impact, which could be mitigated by revising the plan.

- The *Manual on Uniform Traffic Control Devices* signal warrants will be used to assess the appropriateness of the traffic control devices (either signal or roundabout) proposed in the

two alternatives. If it is determined based upon all available information and forecasts that a traffic control device is proposed at a location that does not meet minimum signal warrants, this would be considered to be a significant impact.

IMPACT ANALYSIS

Intersection LOS

Four Lane / Signals

Intersection LOS conditions for this alternative are summarized in Table 15 for 2008 conditions, and Table 25 for 2028 conditions. Comparing these results against the standards of significance, in 2008 LOS falls below standards at the unsignalized Secline / SR 28 and Fox / SR 28 intersections. In 2028, LOS falls below standards at the unsignalized Secline / SR 28, Deer / SR 28, Fox / SR 28, and Chipmunk / SR 28 intersections, as well as the signalized SR 267 / SR 28 intersection. To attain an adequate LOS at the SR 267 / SR 28 intersection, a separate westbound right-turn lane from SR 28 to SR 267 would be required, which would yield LOS D conditions.

Provision of additional side-street turn lanes would not avoid LOS conditions at the unsignalized intersections, as gaps in SR 28 traffic would still remain inadequate to allow left-turn movements onto the highway without excessive delay. Another potential mitigation measure would be to provide a center two-way left-turn lane, allowing drivers to make two-stage left-turn movements onto the highway. To assess this measure, LOS analyses were conducted for the unsignalized intersections assuming the availability of a center two-way left-turn lane. As summarized in Table 32, in 2008 this configuration would provide largely adequate conditions for movements from all side-street approaches, with only a single approach (southbound from Secline Street) exceeding the LOS F threshold (50 seconds) by 3.3 seconds. Under 2028 conditions, LOS F conditions would be provided both at Secline Street and Fox Street, though adequate LOS would be provided at Deer Street and Chipmunk Street.

TABLE 32: 2028 Four-Lane Alternative Peak-Hour Unsignalized Intersection LOS With Two-Way Center Turn Lane

		Side Street LOS			
		Northbound		Southbound	
SR 28 @	Traffic Control	Delay (s/veh)	LOS	Delay (s/veh)	LOS
2008					
Secline Street	Two-Way Stop Controlled	43.7	E	53.3	F
Deer Street	Two-Way Stop Controlled	13.1	B	15.5	C
Fox Street	Two-Way Stop Controlled	—	—	26.8	D
Chipmunk Street	Two-Way Stop Controlled	—	—	20.0	C
2028					
Secline Street	Two-Way Stop Controlled	100.0	F	175.0	F
Deer Street	Two-Way Stop Controlled	14.9	B	29.0	D
Fox Street	Two-Way Stop Controlled	—	—	80.5	F
Chipmunk Street	Two-Way Stop Controlled	—	—	31.6	D

As discussed in the following section, a signal is not warranted at the Fox Street or Chipmunk Street intersections under 2008 conditions. However, Warrant 10: Peak-Hour Delay is met at the Secline Street intersection under 2008 conditions. By 2028, two signal warrants would be met at the Fox Street intersection (Warrant 10: Peak-Hour Delay and Warrant 11: Peak-Hour Volume) and no warrants would be met at the Chipmunk Street intersection. Therefore, by 2008 a signal could be constructed at Secline Street, by 2028 a signal could be constructed at Fox Street to mitigate the poor LOS, and no signal could be constructed at Chipmunk Street to mitigate LOS impacts.

Three Lane / Roundabouts

Tables 16 and 26 summarize LOS conditions for this alternative, in 2008 and 2028, respectively. In 2008 LOS falls below standards at the unsignalized Secline / SR 28, Fox / SR 28 and Chipmunk / SR 28 intersections. In 2028, LOS also falls below standards at the unsignalized Deer / SR 28 intersection. All of the intersections assumed to be controlled by roundabouts operate at relatively good (C or better) LOS in both 2008 and 2028, considering both average delay of the worst approach as well as average delay for the entire intersection.

As discussed above, it is not feasible within the definition of this alternative to mitigate the LOS F conditions at the unsignalized intersections, with the exception of providing a roundabout at the Secline / SR 28, Deer / SR 28, Fox / SR 28 and Chipmunk / SR 28 intersections. If it is assumed that a roundabout could not be constructed unless one signal warrant is met, a roundabout could be constructed at Secline Street and Fox Street by 2008 and at Deer Street and Chipmunk Street by 2028.

Roadway Conditions

Four Lane / Signals

Roadway LOS is found to attain standards in both 2008 and 2028.

Three Lane / Roundabouts

As discussed extensively above and summarized in Tables 18 and 27 (for 2008 and 2028, respectively), roadway volumes would significantly exceed the capacity of a three-lane roadway on a regular and recurring basis, in both 2008 and 2028. In the westbound direction (which is the more critical direction), volume would exceed capacity for 302 hours over 72 days in 2008, and for 1,178 hours over 108 days in 2028. On an average August Saturday, queuing would occur for 7 hours per day in 2008, and 12 hours per day in 2028. Peak volumes would exceed capacity by over 400 vehicles per hour in 2008, and by over 500 vehicles per hour in 2028. These conditions far exceed the applicable standards.

To address this deficiency, there are several possible mitigation strategies that merit discussion:

- Expansion of public transit services could potentially reduce traffic volumes. To address the 2008 deficiency, roughly 450 vehicles per hour would need to be removed in the westbound direction. Assuming an average vehicle occupancy of 2 persons per vehicle, this indicates

that 900 transit passengers per hour would need to be served. At an assumed passenger load of 40 persons per bus, this would require 23 buses per hour to provide adequate capacity. At present, existing funding sources limit the public transit program to only two vehicle-trips per hour. From only a financial perspective, operating an additional 21 vehicles per hour in each direction is infeasible. Moreover, actually generating the necessary ridership even if the service could be provided would undoubtedly require substantial auto use restrictions.

- A new roadway could be constructed, effectively bypassing downtown Kings Beach by connecting SR 267 north of Kings Beach with SR 28 to the east. However, a new roadway of this magnitude is not consistent with TRPA's plans and policies, and is not feasible.

- The capacity of SR 28 could be improved. Reviewing the capacity analysis presented in Table 17, the key factor that would limit the capacity of a three-lane SR 28 would be the on-street parking, both in terms of the interruptions to through traffic movements associated with drivers maneuvering into and out of the spaces as well as the effect that on-street parking has on driver behavior (as drivers slow while searching for a possible parking space). Table 33 presents a similar analysis of roadway capacity, assuming the elimination of all on-street parking through the key section from Deer Street to Fox Street. A comparison with Table 17 indicates that capacity of SR 28 would be increased by roughly 30 percent.

  The analysis of 3-lane roadway queuing can then be re-calculated, using these increased levels of SR 28 capacity. The results of these analyses are presented in Tables 34 and 35, for 2008 and 2028, respectively. As shown in Table 34, for 2008 conditions the elimination of on-street parking would largely (but not completely) eliminate the periods of traffic queuing: a total of 7 hours of queuing would occur over 2 days in the eastbound direction, and 15 hours over 5 days in the westbound direction. By 2028, however, the growth in traffic volumes would result in 517 hours of traffic queues over 100 days in the eastbound direction and 774 hours of traffic queues over 108 days in the westbound direction. This strategy therefore would not mitigate long-term conditions to a non-significant impact level.

  It should be underscored that elimination of all parking (at least on a block-by-block basis) would be required to gain this benefit in capacity. Even with a few spaces, if an approaching driver sees that there may be a possibility of finding an available parking space they will slow, thereby causing the same effect as if a higher number of on-street spaces were provided. Considering the relative roadway capacity on the various blocks, moreover, elimination of parking for the entire segment from Fox to Deer Streets would be required.

Traffic Volumes on Residential Streets

Four Lane / Signals

As SR 28 roadway volumes would not exceed capacity, and as intersections (with mitigation) would not generate significant delays, no significant diversion of traffic onto residential streets would occur with this alternative.

TABLE 33: Capacity Analysis of 3-Lane SR 28 in Kings Beach With No On-Street Parking

		Forecast Conditions: Kings Beach					
	Observed Conditions: Tahoe City WB	Deer - Bear EB	Bear - Coon EB	Coon - Fox EB	Fox -Coon WB	Coon - Bear WB	Bear - Deer WB
Ideal Capacity (At 25 mph)	*1,500*	1,500	1,500	1,500	1,500	1,500	1,500
Reductions in Capacity							
Pedestrian Crossing							
# Pedestrian Crossings/Hour	*167*	58	144	48	100	144	62
Pedestrians per Group	*2*	2	2	2	2	2	2
# Pedestrian Groups per Hour	*83*	29	72	24	50	72	31
Time Lost per Crossing (sec)	*7*	5	5	7	5	5	7
Total Time Lost per Hour (sec)	*583*	145	360	168	250	360	217
% Time Lost per Hour	*16.2%*	4.0%	10.0%	4.7%	6.9%	10.0%	6.0%
Bicycle Crossing							
# Bicycle Crossings/Hour	*25*	2	2	4	2	2	0
Time Lost per Crossing (sec)	*4*	2	2	2	2	2	2
Total Time Lost per Hour (sec)	*100*	4	4	8	4	4	0
% Time Lost per Hour	*2.8%*	0.1%	0.1%	0.2%	0.1%	0.1%	0.0%
Bicycle Side Friction							
# Bicycles per Hour	*35*	5	5	5	20	20	20
% Time Lost per Hour	*3.0%*	0.4%	0.4%	0.4%	1.7%	1.7%	1.7%
Onstreet Parking Movements							
% Time Lost per Hour	*6.3%*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Parking Space Searching							
% of Entering Traffic Searching for Parking Along Roadway	*24%*	15%	15%	15%	15%	15%	15%
Resulting Impact of Parking Traffic Moving at 20 mph	*21.0%*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Conflicting Driveway Turning Movements							
Number of Driveways	*8*	4	0	8	5	6	5
% Time Lost per Hour	*15.0%*	7.5%	0.0%	15.0%	9.4%	11.3%	9.4%
Truck Loading/Unloading							
% Time Lost per Hour	*2.0%*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Multiplicative Reduction in Capacity	*51.2%*	11.7%	10.5%	19.5%	17.2%	21.6%	16.3%
Resulting Roadway Capacity	*731*	1,324	1,343	1,208	1,242	1,176	1,255
Calculation of Value at Count Station East of SR 267 Corresponding to Capacity at Each Location							
Existing Count On Segment		1,114	1,112	1,078	1,009	1,125	1,121
Existing Count - Just E of 267		1,160	1,160	1,160	1,120	1,120	1,120
Equivalent Capacity Just E of 267		1,370	1,391	1,290	1,353	1,171	1,254

TABLE 34: Summary of 2008 Traffic Queuing With 3-Lane SR 28 – With No SR 28 On-Street Parking

	Direction of Travel		
	Eastbound	Westbound	Both
# Days per Summer On Which Queuing Would Occur	2	5	1
# Hours per Summer of Queuing	7	15	5
Average Daily Hours of Queuing			
- On Fridays in August	0.4	0.0	--
- On Saturdays in August	0.0	0.0	--
- On Sundays in August	0.0	1.0	--
- On Other Weekdays in August	0.0	0.0	--
Maximum # of Hours of Queuing per Day	5	6	--

Number of Days Per Summer On Which Queuing Would Occur By # of Hours Per Day

# Hours of Queuing per Day	Eastbound	Westbound	
0	107	104	--
1	0	2	--
2	1	0	--
3	0	1	--
4	0	1	--
5	1	0	--
6	0	1	--
7	0	0	--
8	0	0	--
9	0	0	--
10	0	0	--
11	0	0	--
12	0	0	--

Number of Summer Hours of Diverted Traffic Volume

Vehicles per Hour)		Hours per Summer		
From	To	Eastbound	Westbound	
1	100	7	11	--
101	200	0	4	--
201	300	0	0	--
301	400	0	0	--
401	500	0	0	--
Total		7	15	--

TABLE 35: Summary of 2028 Traffic Queuing With 3-Lane SR 28 – With No SR 28 On-Street Parking

	Direction of Travel		
	Eastbound	Westbound	Both
# Days per Summer On Which Queuing Would Occur	100	108	100
# Hours per Summer of Queuing	517	774	513
Average Daily Hours of Queuing			
- On Fridays in August	8.2	9.2	--
- On Saturdays in August	8.4	9.4	--
- On Sundays in August	6.0	9.8	--
- On Other Weekdays in August	5.9	7.8	--
Maximum # of Hours of Queuing per Day	10	11	--

Number of Days Per Summer On Which Queuing Would Occur By # of Hours Per Day

# Hours of Queuing per Day	Eastbound	Westbound	
0	8	0	--
1	5	0	--
2	13	3	--
3	16	12	--
4	14	4	--
5	9	8	--
6	6	11	--
7	12	11	--
8	18	19	--
9	7	32	--
10	1	6	--
11	0	3	--
12	0	0	--
13	0	0	--
14	0	0	--
15	0	0	--

Number of Summer Hours of Diverted Traffic Volume

Diverted Traffic Volume (1-Way Vehicles per Hour)		Hours per Summer		
From	To	Eastbound	Westbound	
1	100	156	164	--
101	200	361	191	--
201	300	0	419	--
301	400	0	0	--
401	500	0	0	--
501	600	0	0	--
601	700	0	0	--
701	800	0	0	--
801	900	0	0	--
Total		517	774	--

Three Lane / Roundabouts

Considering the hourly balance of traffic volume versus capacity over the course of each summer day, the peak daily traffic volume diverting into Kings Beach residential streets (total of both directions) is estimated to equal 4,600 vehicles per day in 2008 and 10,700 vehicles per day in 2028. Even considering the 10th-highest day as a reasonable design period, the diverted traffic volumes are estimated to equal 1,300 and 9,200 vehicles per day in 2008 and 2028, respectively.

Existing traffic volumes on residential streets range up to roughly 1,200 vehicles per hour (such as on Coon Street north of Rainbow Avenue). It can be expected based upon street patterns and the location of the capacity constraint on SR 28 that much of the cut-through traffic activity would be concentrated on Fox Street and Coon Street in the north-south direction, and Speckled Avenue and Dolly Varden Avenue in the east-west direction. Trout Avenue and Rainbow Avenue would be used primarily for east-west traffic along SR 28 avoiding congestion along the state highway. In addition, Coon Street would attract a higher proportion of traffic diverting off of SR 267 bound to SR 28 eastbound, as the roundabout would provide much easier access onto SR 28. Considering all of these factors, it is estimated that 60 percent of cut-through traffic would occur on Coon Street, resulting in a design cut-through volume of approximately 800 vehicles per day in 2008 and 5,500 vehicles per day in 2028. Adding these volumes to the existing volume of 1,200 results in total traffic volumes of 2,000 and 6,700 vehicles per day in 2008 and 2028, respectively. This latter volume would exceed the standards of significance of 3,000 vehicles per day. Moreover, the limited roadway widths, high density of housing, and high level of pedestrian activity and children playing in or near these streets indicate that the increase in traffic would result in substantial safety deficiencies.

As discussed above, it is not feasible to address this impact through provision of increased public transit, or through construction of a new roadway. Moreover, the analysis of elimination of on-street SR 28 parking indicates that by 2028 traffic queuing would grow to levels where diverted traffic would still result in diversion of traffic onto residential streets that would result in significant impacts.

Another potential measure that could address the impact on residential streets would be to modify the residential street network to discourage or eliminate through traffic. Examples of neighborhood residential "traffic calming" programs can be found in urban areas, such as Berkeley and east Sacramento.

Drivers faced with traffic delays will tend to use the travel path that provides the shortest travel time. To effectively reduce through traffic, therefore, it would be necessary to result in travel times using the residential streets that equal or exceed the travel time along SR 28 under queue conditions. An indication of the level of traffic calming that would be required can thus be gained by considering travel times on the various potential routes:

- In the westbound direction, drivers will generally start diverting into the residential streets once the traffic queue forms back to Coon Street or Fox Street, and then wind through the residential street to emerge onto SR 267 at Dolly Varden Avenue or Speckled Avenue. Drivers staying on SR 28 will be faced with roughly 0.4 miles of congested travel, followed

by 0.7 miles of travel under relatively uncongested conditions after the traffic queue passes the constricted capacity area. At average travel speeds of 5 mph under congested conditions (based upon typical speeds observed in Tahoe City) and 20 mph in uncongested conditions, staying on the state highways would take 6.5 minutes to travel from SR 28 / Fox Street to SR 267 / Speckled Avenue.

- In the eastbound direction, significant traffic diversion can be expected to start to occur once the traffic queue forms back through the SR 267 / SR 28 intersection and northward on SR 267 to the point where a driver heading southbound on SR 267 would see this queue before they pass Speckled and Dolly Varden Avenues. Over time, drivers familiar with the traffic patterns would start to use these two roadways to avoid SR 28 even if they don't observe a traffic queue from a point on SR 267 north of these roadways. From Speckled and Dolly Varden Avenues, most drivers would probably use Coon Street to re-enter SR 28, as it would be the easternmost point served by a roundabout for easy entry. If they stay on the highway, these drivers would be faced with 1.1 miles of traffic queue, which would require 13 minutes to travel through at 5 miles per hour.

- In comparison, the residential streets between SR 28 / Coon Street and SR 267 / Speckled Avenue provide a 1.2-mile travel path. At an average of 20 miles per hour, this route takes roughly 4 minutes.

Comparing these figures, a traffic calming plan would need to add nine minutes of delay to the residential street route in order to eliminate through traffic in both directions. If it is assumed that a typical traffic calming device (such as a speed hump, traffic circle, or choker) adds 10 seconds of delay, each potential travel route through the street grid would need to face a driver with roughly 54 traffic calming devices (or roughly four per block). To address all of the potential cut-through routes, a total of roughly 250 such traffic calming devices would be required to cover the entire street grid. This strategy is not feasible.

Another approach would be to break up the through travel routes by selective street closings, or by changing streets into one-way segments, with the direction of travel alternating every two blocks. This could substantially lengthen the travel distance through the residential grid. At a 20 mph average travel speed, however, travel distance would need to be increased by 3.3 miles in order to eliminate through traffic. This would be roughly equivalent to forcing drivers to "double back" between SR 28 and Speckled Avenue three times. Even if successful in eliminating through traffic, this strategy would increase the traffic levels generated by local traffic (as each local trip would be substantially lengthened) and would probably result in traffic volumes on residential streets that exceed the standard. This approach is therefore also not feasible.

A final strategy would be to simply eliminate all through travel routes on the residential street grid between SR 28 and SR 267. The simplest approach (as it would only require two street changes) would be to close Speckled Avenue and Dolly Varden Avenue just east of SR 267. All traffic into and out of the residential neighborhood would then be provided via SR 28. This would result in some increase in volumes on the north-south streets (including the truck traffic associated with the industrial uses along Speckled Avenue), but given the low level of traffic volumes on Speckled and Dolly Varden this shift would not cause significant impacts on residential streets or on intersection LOS.

This program would also need to eliminate the use of the east-west streets as a means for westbound and eastbound drivers on SR 28 to avoid traffic queues. In particular, it can be expected that Trout Avenue from Deer Street and Rainbow Avenue from Secline Street would be used by eastbound drivers that are aware that the Coon Street roundabout would allow them to avoid all or most of the traffic queue on the state highway, as well as westbound drivers that would have a relatively simple right-turn movement back onto the highway. Smaller traffic control devices (such as speed humps, chokers or traffic circles) would probably not be appropriated, as they cause snow removal problems and would not provide enough travel delay to address the problem. A feasible strategy could consist of the following:

- ❑ Conversion of Trout Avenue from Bear Street to Deer Street to one-way eastbound.

- ❑ Conversion of Steelhead Avenue from Bear Street to Deer Street to one-way eastbound.

- ❑ Construction of a "diagonal diverter" in the Rainbow Avenue / Deer Street intersection, from the northwest corner to the southeast corner. This would be a substantial physical barrier that would require all approaching northbound traffic on Deer Street to turn left onto Rainbow Avenue westbound, and all southbound traffic on Deer Street to turn left onto Rainbow Avenue eastbound (and vice versa).

- ❑ Construction of a second diagonal diverter in the Golden Avenue / Deer Street intersection, from the southwest corner to the northeast corner, thereby requiring eastbound traffic on Golden Avenue to turn left onto Deer Street northbound.

This strategy would provide a shortest eastbound cut-through route for drivers leaving SR 28 at Secline or Deer that requires travel north to Loch Levon Avenue, which would increase travel time sufficiently to yield a longer travel time than staying on SR 28.

Together, the two street closures, two street one-way conversions and two diagonal diverters would eliminate the potential for significant cut-through traffic volumes and avoid changes in traffic patterns that would exceed the 3,000 vehicle-per-day standard for residential street traffic level. However, by eliminating the ability of neighborhood streets to relieve traffic queues on SR 28, traffic queues and delays on the state highways would increase dramatically.

Table 36 and Figure 9 presents an analysis of the total length of queue that would form on the first day of August (which represents a busy but not peak day) in 2008 and 2028 if traffic was required to queue due to the lack of diversion routes. As shown, in 2008, eastbound queues totaling 2.5 miles in length would form, while westbound queues would total 4.3 miles in length. At an average speed of 6 miles per hour (based on observed travel speed through the Tahoe City queue), the average peak-hour delay would equal 25 minutes in the eastbound direction and 43 minutes in the westbound direction. By 2028, queues would approach 29 miles in length in both directions, with delays exceeding four hours. In reality, of course, many drivers faced with this level of delay would abort their trip, or change their travel time. However, delays would still remain very long. In short, the street modifications presented above could address the impact on residential streets, but only by significantly worsening the already-deficient conditions on the state highways.

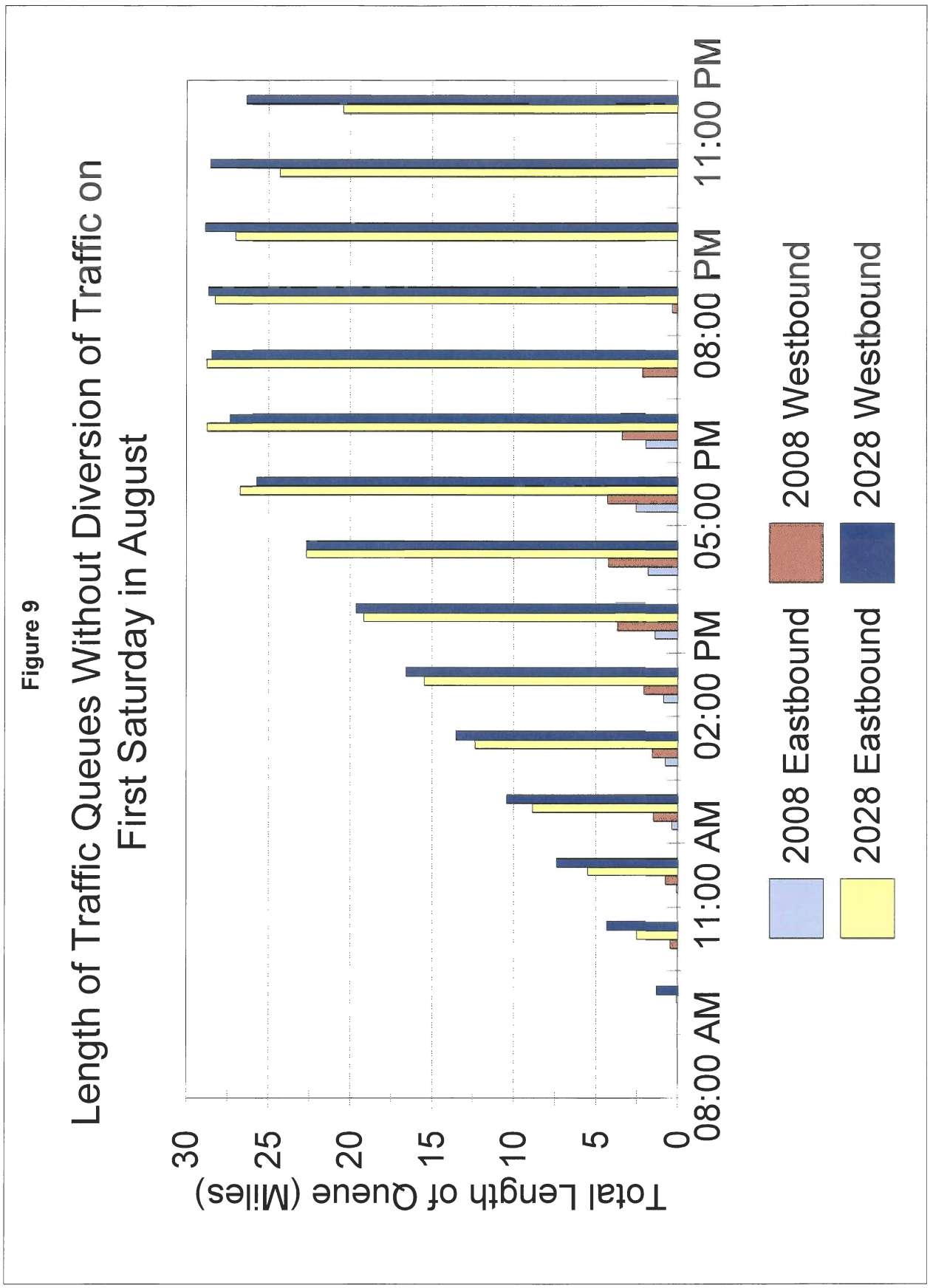
TABLE 36: Traffic Queuing With 3 Lane SR 28 and No Diversion

First Saturday in August

	2008		2028	
	Eastbound	Westbound	Eastbound	Westbound
Length of Queue (Miles)				
08:00 AM	0.0	0.0	0.0	0.0
09:00 AM	0.0	0.0	0.1	1.3
10:00 AM	0.0	0.5	2.5	4.3
11:00 AM	0.0	0.7	5.5	7.4
12:00 PM	0.3	1.5	8.8	10.4
01:00 PM	0.7	1.5	12.3	13.5
02:00 PM	0.8	2.1	15.5	16.5
03:00 PM	1.4	3.6	19.1	19.6
04:00 PM	1.8	4.2	22.7	22.7
05:00 PM	2.5	4.3	26.7	25.7
06:00 PM	1.9	3.4	28.7	27.4
07:00 PM	0.0	2.1	28.8	28.4
08:00 PM	0.0	0.3	28.3	28.6
09:00 PM	0.0	0.0	27.0	28.8
10:00 PM	0.0	0.0	24.3	28.6
11:00 PM	0.0	0.0	20.4	26.4
Estimated Travel Delay (Minutes)				
08:00 AM	0	0	0	0
09:00 AM	0	0	1	13
10:00 AM	0	5	25	43
11:00 AM	0	7	55	74
12:00 PM	3	15	88	104
01:00 PM	7	15	123	135
02:00 PM	8	21	155	165
03:00 PM	14	36	191	196
04:00 PM	18	42	227	227
05:00 PM	25	43	267	257
06:00 PM	19	34	287	274
07:00 PM	0	21	288	284
08:00 PM	0	3	283	286
09:00 PM	0	0	270	288
10:00 PM	0	0	243	286
11:00 PM	0	0	204	264

SR 28 Count Station.wb3/Delays with no Diversion

Figure 9


Length of Traffic Queues Without Diversion of Traffic on First Saturday in August
Total Length of Queue (Miles)
0
5
10
15
20
25
30
08:00 AM
11:00 AM
02:00 PM
05:00 PM
08:00 PM
11:00 PM
2008 Eastbound
2008 Westbound
2028 Eastbound
2028 Westbound

Consistency with Kings Beach Community Plan

Table 37 presents an assessment of the consistency of each alternative with the adopted objectives and policies of the Kings Beach Community Plan, as adopted by TRPA and Placer County in 1996. Of those objectives and policies that pertain to the project, the Four Lane / Signals alternative would be consistent with the Community Plan, so long as adequate sidewalks are provided. The Three Lane / Roundabout alternative would not be consistent with the Community Plan, as the roadway traffic congestion conflicts with several traffic circulation goals and policies as well as conflicting with the transit objective (as transit services would be negatively impacted by traffic congestion).

Consistency with Traffic Signal Warrants

A signal warrant analysis was conducted for the study area intersections for existing summer PM peak-hour design volumes, forecasted 2008 PM peak-hour design volumes, and forecasted 2028 peak-hour design volumes. As Caltrans has jurisdiction along SR 28, the signal warrant analysis is based upon Caltrans standards. While there are no adopted warrants for installation of a roundabout, for purposes of this study the signal warrants are also assumed to be pertinent guidance regarding the placement of a roundabout, as both signals and roundabouts are intended as traffic control devices.

Signal Warrant Analysis – Existing Conditions

The *Manual of Uniform Traffic Control Devices* (MUTCD) (Federal Highways Administration, 1988) is the current adopted document used by Caltrans to determine whether a signal is warranted (while the Federal Highway Administration updated this document in 2000, the more recent version has not been incorporated into the Caltrans Traffic Manual). Caltrans' *Traffic Manual* (November, 1966, as revised) incorporates the MUTCD warrants as important elements in the decision to locate a new traffic signal, as follows:

> "*The justification for the installation of a traffic signal at an intersection is based on the warrants stated in this Manual and in the Manual On Uniform Traffic Control Devices published by the Federal Highway Administration. The decision to install a signal should not be based solely upon the warrants, since the installation of traffic signals may increase certain types of collisions. Delay, congestion, approach conditions, driver confusion, future land use or other evidence of the need for right of way assignment beyond that which could be provided by stop signs must be demonstrated*" (p 9-1).

Eleven warrants for traffic signals are cited in Section 4-C of the MUTCD and in Chapter 9 of the Caltrans Traffic Manual. The specific values used in these warrants depend upon the characteristics of the study site. Site conditions for the SR 28 intersections are assumed as follows:

- Under the Four Lane / Signals alternative, there are two lanes to accommodate through movements along SR 28 at each study intersection. Under the Three Lane / Roundabout

TABLE 37: Project Consistency with Kings Beach Community Plan Applicable Goals, Objectives, and Policies (1/3)

Kings Beach Community Plan Goals and Policies		Alternative: Three Lanes with Roundabouts — Consistency with Community Plan	Three Lanes with Roundabouts — Discussion	Four Lanes with Traffic Signals — Consistency with Community Plan	Four Lanes with Traffic Signals — Discussion
Traffic Circulation and Parking Goal:	Reduce dependency on the automobile and improve the movement of people, goods, and services within Kings Beach and the Region consistent with the economic and environmental goals of the Community Plan.	No	While sidewalk improvements would reduce automobile dependency, recurring traffic congestion would degrade the movement of people, goods and services both within Kings Beach and the Region	Yes	Sidewalk improvements could be provided while avoiding degradation in movement of drivers, passengers, goods and services.
Objective 1:	Provide a safe and efficient transportation system for the residents of the Kings Beach area and others who use the system.	No	Recurring traffic congestion would not be efficient. In addition, through traffic diverting onto residential streets would reduce safety	Yes	Safety could be enhaced by traffic calming measures to moderate traffic speeds on SR 28.
Policy 1a:	The level of service on major roadways(i.e. arterial and collector routes as defined by Placer County) shall be LOS D, and signalized intersections shall be LOS D (Level of Service E may be acceptable during peak periods, not to exceed four hours per day).	No	Recurring traffic congestion on SR 28.	Yes	Roadway and intersections meet LOS standards through 2004, with mitigation.
Policy 1b:	Provide for the various functions currently accommodated in the public rights-of-way (e.g. through vehicle traffic, parking search, pedestrian activity, bicyclist activity, and parking).	No	Reducing capacity below existing and future traffic demand levels does not accommodate through vehicle traffic.	Yes	So long as final design provides adequate sidewalks.
Policy 1c:	Implement a parking management program that provides: adequate parking, limits traffic, considers connections between parking lots, encourages community parking lots, and complements transit.	Possibly	Should be incorporated into detailed planning.	Possibly	Should be incorporated into detailed planning.
Policy 1d:	When designating transportation improvements, consider traffic calming strategies such as alternative truck routes, speed reductions on State Route 28, entry features, highlighted pedestrian cross walks, etc.	Possibly	Should be incorporated into detailed planning.	Possibly	Should be incorporated into detailed planning.

TABLE 37: Project Consistency with Kings Beach Community Plan Applicable Goals, Objectives, and Policies (2/3)

Kings Beach Community Plan Goals and Policies		Alternative: Three Lanes with Roundabouts — Consistency with Community Plan	Three Lanes with Roundabouts — Discussion	Alternative: Four Lanes with Traffic Signals — Consistency with Community Plan	Four Lanes with Traffic Signals — Discussion
Objective 2:	Provide for sufficient capital improvements to meet the level of service target, meet the target for VMT reductions, and to provide adequate parking facilities as development occurs in the Community Plan area.	No / Not Applicable	Does not meet level of service target. Project not intended to address VMT reduction, or to address parking associated with development	Yes / Not Applicable	Meets level of service target, with mitigation. Project not intended to address VMT reduction, or to address parking associated with development
Policy 2e:	Provide sufficient funding to finance the projects in the Capital Improvement Program (CIP).	Not Applicable		Not Applicable	
Objective 3:	The Kings Beach Commercial Community Plan should promote land use changes and development patterns which will encourage the use of alternative transportation modes and reduce travel distances with the Community Plan.	Not Applicable / Yes	The project does not change land use patterns. Provision of sidewalks encourages use of alternative transportation modes.	Not Applicable / Yes	The project does not change land use patterns. Provision of sidewalks encourages use of alternative transportation modes.
Policy 3a:	The Plan should provide for the in-fill of existing developed areas that would utilize existing transportation facilities, while promoting alternatives to the private automobile.	Not Applicable / Yes	The project does not change land use patterns. Provision of sidewalks encourages use of alternative transportation modes.	Not Applicable / Yes	The project does not change land use patterns. Provision of sidewalks encourages use of alternative transportation modes.
Objective 4:	The Kings Beach Commercial Community Plan should encourage the use of public and private transit.	No	Recurring traffic congestion on SR 28 would negatively impact transit services.	Neutral	The project does not change transit services. Services would not be negatively impacted by traffic congestion.
Policy 4a:	Provide for the opportunity for water transit service.	Not Applicable		Not Applicable	
Objective 5:	The Plan shall develop sidewalks along both sides of SR 28 and local commercial streets. This includes landscaping, lighting, trash receptacles and bicycle racks.	Yes		Yes	
Policy 5a:	Implement a program through review of projects or preferable through improvement districts that provides for the street improvements.	Yes		Yes	

TABLE 37: Project Consistency with Kings Beach Community Plan Applicable Goals, Objectives, and Policies (3/3)

Kings Beach Community Plan Goals and Policies		Alternative: Three Lanes with Roundabouts — Consistency with Community Plan	Three Lanes with Roundabouts — Discussion	Alternative: Four Lanes with Traffic Signals — Consistency with Community Plan	Four Lanes with Traffic Signals — Discussion
Objective 6:	The Kings Beach Commercial Community Plan should develop a bicycle recreational trails network with connections to recreation and commercial land uses.	Yes		Yes	
Policy 6a:	Provide for a system of bicycle recreation trails in the community plan improvement program.	Yes		Yes	
Objective 8:	Transportation System Management (TSM) measures should be provided to improve the efficiency of the existing transportation system within the Community Plan.	Not Applicable		Not Applicable	
Policy 8a:	Driveways and access-egress point to commercial businesses along State Route 28 should be coordinated to reduce the number of turn movements and improve the flow along State Route 28.	Yes	The number of access points along SR 28 would be reduced.	Yes	The number of access points along SR 28 would be reduced.
Policy 8b:	Parking within Kings Beach Commercial Community Plan should encourage the consolidation of off-street public parking within the commercial streets.	Yes	So long as loss of SR 28 parking is addessed by provision of equal number of spaces in new public parking areas.	Yes	So long as loss of SR 28 parking is addessed by provision of equal number of spaces in new public parking areas.
Objective 9:	The Community Plan for Carnelian Bay, Tahoe Vista, Kings Beach, and North Stateline all purpose the completion of a follow-up study, after Plan adoption, that will examine a number of transportation issues affecting SR 28. This study, intended to involve Caltrans, Placer County, TRPA, and interested citizens, will examine such issues as the appropriate number of travel lanes on the highway, the use of center medians, techniques for "traffic calming," and regulation of travel speed.	Yes	The project addessess these issues, at least for the Kings Beach area.	Yes	The project addessess these issues, at least for the Kings Beach area.

Source: *North Tahoe Community Plan, TRPA, Adopted April 1, 1996.*
LSC Transportation Consultants, Inc.

KB Com Plan Consistency.wb3

alternative, there are two through lanes on SR 28 at SR 267, and one through lane at the other locations.

- The 85th percentile speed along SR 28 was assumed to be approximately 30 miles per hour.
- With the exception of the SR 267 / SR 28 intersection, none of the minor street approaches are striped with separated left, through, or right-turn lanes. However, the southbound approaches of Secline Street and Bear Street SR 28 approaches are relatively wide and are observed to be typically used as if there are separate right-turn lanes. Therefore, it was assumed that these approaches do have separate right-turn lanes in the LOS analysis, but were considered one-lane approaches for the remainder of the warrant analysis.
- Signal warrant analyses are based upon "typical" traffic levels, rather than the relatively high design volumes used in other portions of this analysis. It is estimated that a typical level of traffic activity along the state highways is reflected in the 100th highest peak-hour volumes, as shown in Table 5. The design-hour volumes for the state highways shown in Table 8 were therefore adjusted to reflect the 100th-highest peak-hour. The resulting volumes are presented in Appendix F.
- It is also necessary to estimate fourth-highest and eighth-highest volumes for some of the warrants. Estimates of the fourth-highest and eighth-highest peak-hour volumes based upon available hourly count data. To do this, hourly count data between June 2, 2002 and September 30, 2002 along SR 28 just east of SR 267 was reviewed. Out of the three days with volumes most closely matching the 100th highest hour, the fourth highest peak-hour volume was approximately 87 percent of the peak-hour volume and the eighth highest peak-hour volume was approximately 87 percent of the peak-hour volume along SR 28. Therefore, it was assumed, for example, that the fourth-highest peak-hour volume per day on the SR 28 approaches were 80 percent of the design peak-hour volume shown in Table 8. However, in 2028 traffic volumes on SR 28 will be more consistent over a longer period of the day, due to capacity constraints. For the SR 28 through volumes, analysis of the hour-by-hour data for the average Saturday in August indicates that the fourth-highest peak-hour volume will be equal to the peak-hour, while the eighth-highest peak-hour volume will be 95 percent of the peak hour.
- As eight hours of count data is available at the Secline Street, Deer Street, Bear Street, and Fox Street intersections, the fourth highest and eighth highest peak-hour approach volumes on the minor street approaches were estimated by multiplying the ratio of the fourth and eighth-highest volumes to peak-hour volumes as determined from the raw traffic count data by the design volumes. The four-hour and eight-hour turning-movement volumes at the Coon Street, and Chipmunk Street intersections were estimated assuming that the traffic variation along these side streets is equal to the average side street volume variation of the intersections for which there is data (Secline, Deer, Bear, and Fox). The variation of traffic on SR 267 was assumed to equal the variation of traffic on SR 28. The 2002 four-hour and eight-hour volume data is presented in Table 38.
- Accident data is available from 1997 through 1999 at each of the study intersections, as reported in the Traffic Operational Analysis Report: State Route 28 in Kings Beach (Caltrans, January 4, 2001). This accident data is also summarized in Table 38.

Table 38: Additional Data Used in 2002 SR 28 Signal Warrant Analysis

	Peak-Hour		Estimated 4-Hr Volume		Estimated 8-Hr Volume			
SR 28 @	Major Street Approach Volume - Total of Both Directions (vph)	Volume on higher-volume approach (vph)	Major Street Approach Volume - Total of Both Directions (vph)	Minor Street Approach	Major Street Approach Volume - Total of Both Directions (vph)	Minor Street Approach	Number of Accidents in 3-Year Period (1997 through 1999)	Average Number of Accidents per Year (1997 through 1999)
267	1,948	536	1,695	482	1,364	429	9	3
Secline	2,071	53	1,802	41	1,450	23	14	5
Deer	2,055	25	1,788	15	1,439	4	15	5
Bear	1,974	92	1,717	57	1,382	30	5	2
Coon	1,857	194	1,616	118	1,300	60	13	4
Fox	1,823	82	1,586	35	1,276	23	13	4
Chipmunk	1,754	31	1,526	19	1,228	10	8	3

Source: LSC Transportation Consultants, Inc. KB Signal Warrant.wb3

- ❑ Pedestrian count data is available for the following locations and time periods:
  - SR 267 / SR 28, January 4, 2003, 8:00 AM to 5:50 PM
  - SR 28 / Secline Street, July 31, 1999, 9:00 AM to 5:00 PM
  - SR 28 / Deer Street, August 21, 1999, 8:15 AM to 4:15 PM
  - SR 28 / Bear Street, July 10, 1999, 8:00 AM to 4:00 PM
  - SR 28 / Fox Street, August 21, 1999, 8:00 AM to 4:00 PM

  However, no pedestrian count data is available at Coon Street or Chipmunk Street. Informal observation by LSC staff indicates the pedestrian crossing activity is relatively high at Coon Street (at last equal to Bear Street) but relatively low at Chipmunk Street.

Based upon these assumptions, the results of the signal warrant analysis for the existing (2002) conditions is summarized in Table 39, as follows:

Warrant 1: Minimum Vehicular Volume: For each of eight hours on an "average" day (defined as a weekday representing traffic volumes normally and repeatedly found at the location), a minimum volume of 600 vehicles per hour must be present on the total of the two major approaches *and* a minimum of 150 vehicles per hour must be present on the higher of the minor street approaches for one-lane approaches and 200 vehicles per hour on two-lane approaches.

Based upon the estimated eight-hour traffic volumes, this warrant is met for SR 267 / SR 28 only.

Warrant 2: Interruption of Continuous Traffic: For each of eight hours on an average day, a minimum volume of 900 vehicles per hour must be present on the total of the two major approaches *and* a minimum of 75 vehicles per hour must be present on the higher of the minor street approaches for one-lane approaches and greater than 100 vehicles per hour on two-lane approaches.

Based upon the estimated eight-hour traffic volumes, this warrant is met for SR 267 / SR 28 only.

Warrant 3: Minimum Pedestrian Volume: The pedestrian volume crossing the major street during an average day is 100 or more for each of any four hours, or 190 or more during any one hour, *and* there shall be less than 60 gaps per hour in the traffic stream of adequate length for pedestrians to cross.

Although data regarding the number of gaps in traffic present on SR 28 is not available, this warrant is probably met at the SR 28 / Bear Street and SR 28 / Coon Street intersections based upon available pedestrian count data.

Warrant 4: School Crossing: A traffic control signal may be warranted at an established school crossing when a traffic engineering study of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size of groups of school children at the school crossing

Table 39: Existing (2002) Conditions Signal Warrant Analysis: SR 28 from SR 267 to Chipmunk Street

SR 28 @	Warrant 1 Minimum Vehicle Volume	Warrant 2 Interruption of Continuous Traffic	Warrant 3 Minimum Pedestrian Volume	Warrant 4 School Crossings	Warrant 5 Progressive Movement	Warrant 6 Accident Experience	Warrant 7 Systems	Warrant 8 Combination of Warrants	Warrant 9 Four Hour Volumes	Warrant 10 Peak Hour Delay	Warrant 11 Peak Hour Volume	Number of Warrants Met
SR 267	Yes	Yes	No	No	Not Applicable	No	Yes	No	Yes	Not Applicable	Yes	5
Secline Street	No	No	No	No	Not Applicable	No	No	No	No	No	No	0
Deer Street	No	No	No	No	Not Applicable	No	No	No	No	No	No	0
Bear Street	No	No	Yes	No	Not Applicable	No	No	No	No	No	No	1
Coon	No	No	Yes	No	Not Applicable	No	No	No	Yes	Not Applicable	Yes	3
Fox Street	No	No	No	No	Not Applicable	No	No	No	No	No	No	0
Chipmunk Street	No	No	No	No	Not Applicable	No	No	No	No	No	No	0

Source: LSC Transportation Consultants, Inc.

KB Signal Warrant.wb3

shows that the number of adequate gaps in the traffic stream during the period when the children are using the crossing is less than the number of minutes in the same period.

As there is no established school crossing along SR 28 in Kings Beach, this warrant is not potentially applicable to any of the SR 28 study intersections.

Warrant 5: Progressive Movement: Progressive movement control sometimes necessitates traffic signal installations, in order to maintain proper grouping of vehicles and effectively regulate group speed. The installation of a signal according to this warrant should not be considered where the resultant signal spacing would be less than 1,000 feet.

This warrant is not applicable to SR 28 in Kings Beach.

Warrant 6: Accident Experience: This warrant is satisfied when: (1) adequate trial of less restrictive remedies has failed to reduce the accident frequency, (2) five or more reported accidents, of types susceptible to correction by traffic signal control, have occurred within a 12-month period, each accident involving personal injury or property damage, (3) there exists a volume of pedestrian or vehicular traffic not less than 80 percent of the requirements specified in Warrants 1, 2, or 3, and (4) the signal will not seriously disrupt progressive traffic flow.

Secline Street and Deer Street were the only intersections along SR 28 that reported an average accident rate per year of five or more for the 1997 through 1999 traffic data. As the available data does not indicate the types of accidents that occurred, the ability to remedy these accidents can not be determined. Regardless, these intersections do not meet the corresponding volume requirements. Therefore, this warrant is not met at any of the SR 28 study intersections.

Warrant 7: Systems Warrant: Applicable at a location of two or more major routes with either: (1) a total entering volume of at least 1,000 vehicles per hour and five-year projected volumes that meet Warrants 1, 2, 8, 9, or 11, or (2) a total entering volume of at least 1,000 vehicles for each of any five hours of a Saturday and/or Sunday.

As none of the local side streets are "major routes," this warrant is met at the SR 28 / SR 267 intersection only.

Warrant 8: Combination of Warrants: In exceptional cases, signals may occasionally be warranted where no single warrant is satisfied but where Warrants 1 and 2 are satisfied to the extent of 80 percent or more of the stated values.

This warrant is not applicable to any of the SR 28 intersections.

Warrant 9: Four Hour Volumes: Warrant is satisfied when, for each of any four hours or more of an average day, the plotted points representing the vehicles per hour on the major street and the corresponding vehicles per hour on the higher volume minor street approach all fall above the curve presented in Figure 4-7 for the existing combination of approach lanes. As the volume on the major street exceed the range of the x-axis in Figure 4-7, it can be determined that the side

street volumes at the study intersections must exceed 80 vehicles per hour for single-lane side-street approaches and 115 vehicles per hour for two-lane side-street approaches to meet this warrant.

This warrant is met at the SR 28 / SR 267 and SR 28 / Coon Street intersections.

Warrant 10: Peak Hour Delay Warrant – Met when: (1) the total delay experienced by the traffic on one minor street approach controlled by a Stop sign during the peak-hour equals or exceeds four vehicle-hours for a one-lane approach and five vehicle-hours for a two-lane approach, and (2) the volume on the minor street approach equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes, and (3) the total volume entering the intersection equals or exceeds 800 (for a four-leg or more intersection) or 650 (for a three-leg intersection). As the volume on the major street exceed the range of the x-axis in Figure 4-7, it can be determined that the side street volume must exceed 80 vehicles per hour for single-lane side-street approaches and 115 vehicles per hour for two-lane side-street approaches.

As the volume requirements are not met, this warrant is not met at any of the study intersections.

Warrant 11: Peak Hour Volume – Warranted when the plotted point representing the vehicles per hour on the major street and the corresponding vehicles per hour on the higher of the minor street approach falls above the curve in Figure 4-5. As the volume on the major street exceed the range of the x-axis in Figure 4-5, it can be determined that the side street volumes at the study intersections must exceed 100 vehicles per hour for single-lane side-street approaches and 150 vehicles per hour for two-lane side-street approaches to meet this warrant

This warrant is met at the SR 28 / SR 267 and SR 28 / Coon Street intersections, and is not met at the remaining intersections. In particular, the highest-volume side street approach volume on Bear Street is 92, while the volume required to meet the Peak Hour Volume Warrant is 100.

Signal Warrant Analysis – 2008 Conditions

The 2008 signal warrant analysis was based upon the2008 100th highest peak-hour volumes presented in Appendix F. These volumes were generated based upon the forecasting methodology identified in LSC's scope for the overall traffic study. Specifically, through volumes on SR 28 were increased by the highest annual average growth rate observed at any one point along SR 28 in the study area between 1991 and 2001 (0.31 percent per year, observed east of Coon Street). No growth in side street volumes was assumed.

Additional volume data used in the analysis may be found in Table 40, while the calculated 2008 intersection LOS is shown in Appendix F. The results of the analysis are shown in Table 41. As Table 41 indicates, most of the same signal warrants are met under the 2008 conditions as are met under the 2002 conditions, particularly because the 2008 design volumes assumed very little growth on the side-street traffic. Exceptions to this are discussed below.

Table 40: Additional Data Used in 2008 and 2028 SR 28 Signal Warrant Analysis

SR 28 @	Peak-Hour - Total of Both Directions (vph)	Peak-Hour higher-volume approach (vph)	Estimated 4-Hr Volume - Total of Both Directions (vph)	Estimated 4-Hr Volume Minor Street Approach	Estimated 8-Hr Volume - Total of Both Directions (vph)	Estimated 8-Hr Volume Minor Street Approach
2008 Volume Data						
267	1,966	559	1,710	503	1,376	447
Secline	2,107	53	1,833	41	1,475	23
Deer	2,091	25	1,819	15	1,464	4
Bear	2,052	79	1,785	49	1,436	26
Coon	1,880	224	1,636	137	1,316	69
Fox	1,859	82	1,617	35	1,301	23
Chipmunk	1,790	31	1,557	19	1,253	10
2028 Volume Data						
267	2,546	991	2,546	892	2,419	793
Secline	2,654	70	2,654	54	2,521	31
Deer	2,626	51	2,626	31	2,495	9
Bear	2,609	93	2,609	58	2,479	31
Coon	2,348	313	2,348	191	2,231	97
Fox	2,310	122	2,310	52	2,195	34
Chipmunk	2,214	56	2,214	34	2,103	17

Source: LSC Transportation Consultants, Inc. KB Signal Warrant.wb3

Table 41: 2008 Conditions Signal Warrant Analysis: SR 28 from SR 267 to Chipmunk Street in Kings Beach, California

SR 28 @	Warrant 1 Minimum Vehicle Volume	Warrant 2 Interruption of Continuous Traffic	Warrant 3 Minimum Pedestrian Volume	Warrant 4 School Crossings	Warrant 5 Progressive Movement	Warrant 6 Accident Experience	Warrant 7 Systems	Warrant 8 Combination of Warrants	Warrant 9 Four Hour Volumes	Warrant 10 Peak Hour Delay	Warrant 11 Peak Hour Volume	Number of Warrants Met
FOUR LANE / SIGNALS ALTERNATIVE												
SR 267	Yes	Yes	No	No	Not Applicable	Additional Info Required	Yes	No	Yes	Not Applicable	Yes	5
Secline Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Deer Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Bear Street	No	No	Yes	No	Not Applicable	Additional Info Required	No	No	No	No	No	1
Coon	No	No	Yes	No	Not Applicable	Additional Info Required	No	No	Yes	Not Applicable	Yes	3
Fox Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Chipmunk Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
THREE LANE / ROUNDABOUTS ALTERNATIVE												
SR 267	Yes	Yes	No	No	Not Applicable	Additional Info Required	Yes	No	Yes	Not Applicable	Yes	5
Secline Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Deer Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Bear Street	No	No	Yes	No	Not Applicable	Additional Info Required	No	No	No	No	No	1
Coon	No	No	Yes	No	Not Applicable	Additional Info Required	No	No	Yes	Not Applicable	Yes	3
Fox Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Chipmunk Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0

Note: Some results differ between 3-lane and 4-lane alternatives, as some warrants are dependent upon the number of through lanes on the major approaches.
Source: LSC Transportation Consultants, Inc.

KB Signal WarrantLwb3

The 2008 conditions signal warrant analysis for the Four Lanes / Signals and Three Lane / Roundabouts alternatives do not differ from the existing condition.

Signal Warrant Analysis – 2028 Conditions

The 2028 signal warrant analysis was based upon the design volumes presented in Appendix F. Additional volume data used in the analysis may be found in Table 40, while the calculated 2028 intersection LOS are provided in the appendix. The results of the analysis are shown in Table 42.

Four Lanes / Signals

The 2028 conditions signal warrant analysis for the Four Lanes / Signals alternative differs from the 2008 condition as follows:

- Warrant 2: Interruption of Continuous Traffic is met at the Coon Street intersection under 2028 conditions.

- Warrant 10: Peak-Hour Delay and Warrant 11: Peak Hour Volume are met at the Fox Street intersection under 2028 conditions.

Three Lane / Roundabouts

The 2028 conditions signal warrant analysis for the Three Lanes / Roundabouts alternative differs from the 2028 condition as follows:

- Warrant 2: Interruption of Continuous Traffic is met at the Coon Street intersection under 2028 conditions.

- Warrant 10: Peak-Hour Delay is met at the Fox Street intersection under 2028 conditions.

Summary

For 2002 conditions, the following intersections are found to meet signal warrants:

- ❑ **SR 28 / SR 267**: Minimum Vehicle Volume Warrant, Interruption of Continuous Traffic Warrant, Systems Warrant, Four Hour Volumes Warrant, and Peak Hour Warrant.

- ❑ **SR 28 / Bear Street**: Minimum Pedestrian Volume Warrant.

- ❑ **SR 28 / Coon Street**: Minimum Pedestrian Volume Warrant, Four Hour Volume Warrant, and Peak Hour Warrant.

Table 42: 2028 Conditions Signal Warrant Analysis: SR 28 from SR 267 to Chipmunk Street in Kings Beach, California

SR 28 @	Warrant 1 Minimum Vehicle Volume	Warrant 2 Interruption of Continuous Traffic	Warrant 3 Minimum Pedestrian Volume	Warrant 4 School Crossings	Warrant 5 Progressive Movement	Warrant 6 Accident Experience	Warrant 7 Systems	Warrant 8 Combination of Warrants	Warrant 9 Four Hour Volumes	Warrant 10 Peak Hour Delay	Warrant 11 Peak Hour Volume	Number of Warrants Met
FOUR LANE / SIGNALS ALTERNATIVE												
SR 267	Yes	Yes	No	No	Not Applicable	Additional Info Required	Yes	No	Yes	Not Applicable	Yes	5
Secline Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Deer Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Bear Street	No	No	Yes	No	Not Applicable	Additional Info Required	No	No	No	No	No	1
Coon	No	Yes	Yes	No	Not Applicable	Additional Info Required	No	No	Yes	Not Applicable	Yes	4
Fox Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	Yes	Yes	2
Chipmunk Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
THREE LANE / ROUNDABOUTS ALTERNATIVE												
SR 267	Yes	Yes	No	No	Not Applicable	Additional Info Required	Yes	No	Yes	Not Applicable	Yes	5
Secline Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Deer Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0
Bear Street	No	No	Yes	No	Not Applicable	Additional Info Required	No	No	No	No	No	1
Coon	No	Yes	Yes	No	Not Applicable	Additional Info Required	No	No	Yes	Not Applicable	Yes	4
Fox Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	Yes	Yes	2
Chipmunk Street	No	No	No	No	Not Applicable	Additional Info Required	No	No	No	No	No	0

Note: Some results differ between 3-lane and 4-lane alternatives, as some warrants are dependent upon the number of through lanes on the major approaches.
Source: LSC Transportation Consultants, Inc.

KB Signal Warrant.wb3

For 2008 conditions, the following intersections are found to meet signal warrants:

Four Lanes / Signals

- **SR 28 / SR 267**: Minimum Vehicle Volume Warrant, Interruption of Continuous Traffic Warrant, Systems Warrant, Four Hour Volumes Warrant, and Peak Hour Warrant.
- **SR 28 / Bear Street**: Minimum Pedestrian Volume Warrant.
- **SR 28 / Coon Street**: Interruption of Continuous Flow Warrant, Minimum Pedestrian Volume Warrant, Four Hour Volume Warrant, and Peak Hour Warrant.

Three Lanes / Roundabouts

- **SR 28 / SR 267**: Minimum Vehicle Volume Warrant, Interruption of Continuous Traffic Warrant, Systems Warrant, Four Hour Volumes Warrant, and Peak Hour Warrant.
- **SR 28 / Bear Street**: Minimum Pedestrian Volume Warrant.
- **SR 28 / Coon Street**: Interruption of Continuous Flow Warrant, Minimum Pedestrian Volume Warrant, Four Hour Volume Warrant, and Peak Hour Warrant.

For 2028 conditions, the following intersections are found to meet signal warrants:

Four Lanes / Signals

- **SR 28 / SR 267**: Minimum Vehicle Volume Warrant, Interruption of Continuous Traffic Warrant, Systems Warrant, Four Hour Volumes Warrant, and Peak Hour Warrant.
- **SR 28 / Bear Street**: Minimum Pedestrian Volume Warrant.
- **SR 28 / Coon Street**: Interruption of Continuous Flow Warrant, Minimum Pedestrian Volume Warrant, Four Hour Volume Warrant, and Peak Hour Warrant.
- **SR 28 / Fox Street**: Peak Hour Delay Warrant and Peak Hour Volume Warrant.

Three Lanes / Roundabouts

- **SR 28 / SR 267**: Minimum Vehicle Volume Warrant, Interruption of Continuous Traffic Warrant, Systems Warrant, Four Hour Volumes Warrant, and Peak Hour Warrant.
- **SR 28 / Bear Street**: Minimum Pedestrian Volume Warrant.
- **SR 28 / Coon Street**: Interruption of Continuous Flow Warrant, Minimum Pedestrian Volume Warrant, Four Hour Volume Warrant, and Peak Hour Warrant.
- **SR 28 / Fox Street**: Peak Hour Delay Warrant and Peak Hour Volume Warrant.